

# Facilitating education in rural areas of South Africa: The role of electricity and other sources of energy

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ADELE GORDON

Rural Education Facilitators Programme  
3rd Floor, 76 Juta Street, BRAAMFONTEIN, 2017

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ENERGY & DEVELOPMENT RESEARCH CENTRE  
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## Executive Summary

### Background information

Eskom has embarked on an ambitious programme, the School Electrification Programme, to supply electricity to the large numbers of schools in South Africa lacking this service. Eskom targeted the year 2001 to connect all schools to either the grid network or provide some form of remote area power supply (which in most instances would be solar photovoltaic panels). High costs are likely to prevent these goals from being realised and it is therefore appropriate at this juncture to examine the actual and potential impact of the programme on key programmes of the national and provincial departments of education.

This paper forms part of an Energy for Development Research Centre programme, 'The role of electricity in the integrated provision of energy to rural areas' and focuses on the most disadvantaged sector of education in South Africa, that is, schools in rural areas. The analysis attempts to take account of the needs of these schools so that electrification supports their participation in key education programmes which require electricity (or another source of energy). It recognises that energy needs of schools must be considered within the framework of emerging policies concerning the provision of energy to rural areas. The Rural Development Strategy of the Reconstruction and Development Programme (RDP) proposes that integrated energy planning will lead to a synergy between development and energy delivery that recognises the multi-faceted nature of rural energy needs (RDP, 1997). All energy sources are being considered and include, electrification, policies to secure fuel wood supplies, and options to improve access to petroleum fuels. The implications of these policies are likely to influence patterns of provision in various sectors, including education.

Even though there are a variety of types of education institutes in rural areas - providing educare, skill-training, technical and tertiary education - the focus of this paper is energy provision to schools offering education from Grade One to Grade 12 and to providers of adult basic education and training where schools are the sites of instruction.

The report begins with a discussion on whether the electrification of schools is indeed a fundamental requirement for meeting key development priorities enunciated by the national and provincial education departments, particularly in supporting principles of democratisation, access, equity and redress. The analysis is based on an examination of post-1994 education legislation and policies as well as programmes currently being planned and implemented, and extended by a brief examination of the potential impact of electricity, which incorporates international and South African studies.

An assessment of the aims and operational procedures of Eskom's grid and non-grid School Electrification Programme follows, and installation procedures examined in two provinces, the Free State and the Northern Province. Issues analysed include: line management functions concerning electricity provision within the provincial departments of education; the consultative process between Eskom agents, education department officials, school management and community structures; the effectiveness of installation, maintenance and security procedures; whether or not equipment provided as part of the installation 'package' for the non-grid programme might add value to teaching and learning; and ongoing operational costs and training programmes for users.

Recommendations in the final part of the report address the lack of national and provincial education policy guidelines regarding a strategic plan for the provision of energy services that expedite the implementation of educational development initiatives. Further recommendations point to the need to establish a clear framework for financing electricity at schools and provide on-going support to schools and other educational institutions, which advance the sustainability of the service. In addition research is needed to examine changes in user practices arising from the provision of electricity, at schools and households, that affect teaching and learning, to support policy planning and implementation in the future.

## Summary of main findings

(These findings are based on a detailed examination of two provinces, the Free State and Northern Province. It is possible that other provinces have a different set of concerns arising from their particular relationship with Eskom.)

### Financing school electrification

Eskom is responsible for obtaining funds for the school electrification programme which are then managed by the Department of Minerals and Energy. The national Department of Education plays no role in this process. As a result the planning process does not appear to take account of all key priorities of the national and provincial education departments, particularly if one considers the targeting of schools, the provision of equipment, and maintenance and operational costs.

### Electricity bills

Provincial departments are or will soon be responsible for paying the electricity bills of all public schools connected to the electricity grid. Interviews with officials revealed that education departments have not developed guidelines on the payment of electricity bills, particularly where schools have a range of equipment and facilities which require electricity. Guidelines must include operating and maintenance costs of essential services and equipment.

### Diversifying decision-making structures

The School Electrification Programme has been developed with little recognition of the diversity of activities at schools and the supportive facilities and services needed to ensure that they function effectively. In fact the decision-making process reflects pre-1994 channels of communication within the national and provincial departments when planning was coordinated by school building and maintenance directorates of the various education departments. Clearly input is needed from other directorates whose services may depend on the provision of electricity, such as Adult Basic Education and Training (ABET) and curriculum affairs.

Recently however school and district personnel have begun to participate in decisions to connect the school/village to the grid or to install solar photovoltaic panels at the school.

### Selected management concerns

It was found that training programmes for the off-grid programme deal with basic maintenance but do not provide information on the advantages of using electricity compared to other forms of energy, and the implications of using certain appliances. The latter also applies where the school is connected to the grid network. This information is essential if schools are to take responsibility for facilities and services at schools.

Vandalism and theft of equipment are common. Eskom requires the school community to ensure the security of the solar photovoltaic panels and equipment by fencing the school and ensuring classrooms have doors with locks. These preconditions could lead to the exclusion of the most needy schools which therefore need support to manage the service.

### Meeting development needs

In time it can be expected that electricity will be essential to ensure the effective delivery of current and future initiatives. Some of these are listed:

#### *Supporting an information system*

Office equipment, including computers, are essential for effective and efficient management. It is not likely that electricity will become available to all schools in the short- and medium term and therefore ways of ensuring that all schools have access to equipment must be found through strategies such as clustering schools or establishing core administrative centres.

### *Curriculum reform*

Transforming the curriculum cannot take place without adequate teacher support and in-service programmes are increasingly being offered by tertiary institutes using distance education programmes. Although print will remain the dominant medium for many years, we can expect that many programmes will be conducted through the electronic media in the not-too-distant future.

Certain learning areas, particularly at the senior secondary level, and possibly during the last phase of general education, require equipment that must be supported by a stable energy source.

Appendix A provides details of the energy requirements for teaching senior secondary science. In this analysis the author, Clerk, maintains that science cannot be taught at this level without some supply of electricity and it appears that solar photovoltaic panels, although not as convenient as a grid connection, will suffice. Similar analyses are needed to cover all learning areas at the different levels of education.

Public awareness programmes of new policies and instructional programmes are being relayed through national television. Means of making these available to rural communities is needed to prevent marginalising them.

### *Open learning programmes, supported by various technologies*

The report by the task team on technology-enhanced learning points to the need to diversify modes of instruction to give more learners access to education and to provide a more flexible array of learning experiences particularly to teachers, adults and youths living in remote areas of South Africa.

### *Modes of provision*

Studies from a range of countries indicate the advantages of establishing learning centres/multiple purpose resource centres in rural areas. This is already being trialed in both the Northern Province and the Free State.

There is insufficient information on the capacity of off-grid systems currently being installed to determine whether they can be extended and upgraded to meet expanding needs, particularly if schools are to be used as multiple-resource centres, or to cater for the needs of different learners at different times of the day.

### *Extra-mural and related programmes at schools*

The lack of any form of energy provision at some schools has a direct bearing on the Primary School Nutrition Programme. Where electricity is not available, learners may miss school to collect wood. It appears that the lack of heating facilities serves to restrict the menu to sandwiches.

Findings suggest the possible expansion of night classes if schools are provided with lights and security.

### **Ensuring teachers' well-being**

Although few in number, studies in South Africa and Southern Africa found that some teachers claim that electricity is not a basic need in view of the poor condition of their schools. Even so they pointed out that educational aids can improve teaching practices and also encourage learners to use schools at night. As yet, there has been little consideration given to providing teachers' homes with electricity where solar photovoltaic panels are installed at schools, despite the benefits of extending teachers' preparation time.

### **Schools on farms**

The electrification of schools on farms remains problematical. At present property-owners and not the department of education decide whether or not to electrify the school and in most cases s/he is still responsible for all costs incurred.

## **Policy directives to facilitate the effective use of energy in rural schools**

### **Preventing the marginalisation of learners in rural areas**

It cannot be disputed that minimum requirements for all schools include secure and safe buildings, sufficient classroom space, water and sanitation, and safe access to school. Provincial departments recognise these as fundamental elements of reform.

Nevertheless other reform measures prioritised in policy documents and legislation pertain to curriculum transformation, access to quality education and the implementation of an education information system. These require a diverse array of educational aids and office equipment, many of which are driven by electricity.

It is essential to ensure that schools in rural areas have the same potential to offer a quality education as schools in urban areas. This requires that arrangements must be made for them to obtain the necessary aids and equipment to do so.

### **Community ownership of energy programmes**

The driving principal behind the electricity programme should be that government and the public utility support community ownership of the programme and not vice versa. This can only be achieved if policies are based on community needs and practices.

### **Improving lines of communication**

At present it is apparent that many officials lack information on Eskom's School Electrification Programme. A reason is that the decision-making process is the same as those developed prior to 1994 as decisions are made by officials in directorates dealing with building services and the provincial department of Public Works. Other directorates, particularly those responsible for all curriculum-related activities, have a direct interest in electricity-supported technology, and should to be drawn into the process.

Eskom and the provincial departments need to reconsider line functions and communication between the various stakeholders, and develop new structures appropriate to the present policies.

### **National Department of Education**

The national and provincial departments of education should play a key role in formulating policy around facilities and services supporting transformation, including examining the cost implications of implementation, maintenance and support.

At national level, officials and Eskom agents will have to formulate guidelines on the suitability and sustainability of a range of energy sources, related implementation and maintenance costs, capacity development and integration with other sectors, such as water affairs. These must take account of Eskom's capacity to deliver and prevailing budgetary constraints as the electrification programme (grid and non-grid) is not likely to electrify all schools in the medium-term.

Consideration is needed on tariffs for the non-grid system (if these are to be introduced), maintenance costs, and the payment of bills for schools connected to the grid network so that provincial departments can prepare electricity budgets. Many 'historically advantaged' schools have in the past paid the bill for various 'luxury' items (such as swimming pools, floodlit sports fields and heaters) out of school funds and provincial departments will not be able to take over these payments. Therefore funding formulae must reflect the use of essential services required by all learners.

### **Provincial departments**

Redistributing resources to ensure equality of provision is clearly not feasible in today's climate of severe budgetary constraints. Promoting equity demands that all learners must have the same potential to access basic education and training to which they are entitled, as enshrined in the Bill of Rights. This does not mean however that every school must be provided with a full range of equipment. Strategies are needed which enable educators and

learners to access a wide variety of learning experiences, using various and suitable resources.

Provincial departments of education should provide district offices with various options designed to promote effective teaching and efficient management practices, allowing communities to decide on the facilities most suited to their particular needs.

Different options might delineate various modes of provision including: all schools having access to some form of electricity; secondary schools having suitable energy sources for various learning areas; all schools using office equipment and teaching aids at district offices or learning centres sited near schools; or a combination of these.

The specialised energy requirements of community learning centres must be determined. In time these centres could house equipment, provide support services to schools and offer the broader community access to telematics education and training programmes to suit their particular education and training needs. These initiatives would work in tandem with Telkom's Rurtel programme and other skill-training programmes.

Finances needed to cover installation, maintenance, security, management of the technology, insurance and technical support for hardware and software must be spelled out.

### **District offices**

District offices must have the capacity to support schools and school clusters in managing the electricity service and equipment provided.

### **Governing bodies**

In some provinces governing bodies and local education officials are already participating in consultative structures at village level. This process should be encouraged so that capacity building operates across the various sectors allowing planning at village level to be tackled in a holistic manner.

With specific reference to school management, governing bodies must participate in deciding on special features of the delivery package provided with the solar photovoltaic panel installation. Excluding governing bodies from decision-making is inimical to policies which devolve decision-making to school level, giving parents responsibility for school governance, including control over the management of facilities and services at the school.

### **Capacity building**

Capacity building programmes relating to energy could be included in programmes on governance currently being planned for school governing bodies. It is essential that members of governing bodies are given training to ensure that their system is safe and effective, and that operational costs are kept to a minimum.

### **Teaching resources for Curriculum 2005**

National and provincial learning area committees have been constituted. These could be requested to identify technologies and teaching aids for their particular learning area and the educational levels at which these are needed. Where appropriate, energy specialists could work with these committees to generate different energy options.

The package presented to schools receiving solar photovoltaic panels includes a television set, a video machine and an overhead projector. An alternative 'package' is recommended which offers schools, or school clusters, a flexible range of options. This requires an analysis of the resources required at various teaching sites, including primary and secondary schools, community learning centres, teacher resource centres, and youth and Adult Basic Education and Training centres.

### **Research, monitoring and evaluation studies**

A programme of research is needed to develop a thorough understanding of user patterns relating to electricity and their effects on teaching and learning in households and at schools. Monitoring and evaluation is essential. Actual usage, technical faults and other problem areas could be monitored by the school. Other information pertinent to the impact of the various energy sources needs to be collected to ascertain whether the programme is meeting its goals.

# Table of Contents

<b>Executive Summary</b>	<b>i</b>
<b>1 Introduction</b>	<b>1</b>
<b>2 Impact studies: Education and rural electricity</b>	<b>2</b>
2.1 Electricity - an essential service?	2
2.2 Conclusions	4
<b>3 Education in rural areas of South Africa</b>	<b>5</b>
3.1 The political economy of rural education	5
3.2 Policies regulating education in rural areas	6
3.3 Service delivery in rural areas	7
3.4 Conclusions	8
<b>4 The policy framework for the education and training system and accompanying legislation</b>	<b>8</b>
4.1 Goals and values	8
4.2 Decision-making structures	9
4.3 Financing education	11
4.4 Special programmes and initiatives	11
4.5 The restructuring of the curriculum	12
4.6 Equipment needed to support teaching and learning and the effective management of schools	17
4.7 Conclusions	18
<b>5 Eskom's School Electrification Programme</b>	<b>19</b>
5.1 Introduction	19
5.2 Background information	19
5.3 Eskom's grid electrification programme	19
5.4 Eskom's school off-grid electricity programme	20
5.5 The electrification of schools on farms	21
5.6 The participation of officials from national and provincial departments of education in the electrification programme	21
5.7 Critical analysis	26
5.8 Conclusions	27
<b>6 Summary of main findings:</b>	<b>28</b>
6.1 Financing school electrification	28
6.2 Diversifying decision-making structures	28
6.3 Selected management concerns	28
6.4 Meeting development needs	29
6.5 Ensuring teachers' well-being	30
6.6 Schools on farms	30
<b>7 Policy directives to facilitate the effective use of energy in rural schools</b>	<b>30</b>
7.1 Preventing the marginalisation of learners in rural areas	30
7.2 Community ownership of energy programmes	30
7.3 Management concerns	30
7.4 Capacity building	32
7.5 Teaching resources for Curriculum 2005	32
7.6 Research, monitoring and evaluation studies	32
<b>References</b>	<b>32</b>
<b>Appendix A: Energy Requirements to Teach Secondary School Science</b>	
<b>Appendix B: Interviewees</b>	

## 1 Introduction

Eskom has embarked on an ambitious programme, the School Electrification Programme, to supply electricity to the large numbers of schools in South Africa lacking this service. Eskom targeted the year 2001 to connect all schools to either the grid network or provide some form of remote area power supply (which in most instances would be solar photovoltaic panels). High costs are likely to prevent these goals from being realised and it is therefore appropriate at this juncture to examine the actual and potential impact of the programme on key programmes of the national and provincial departments of education.

This paper forms part of an Energy and Development Research Centre programme, 'The role of electricity in the integrated provision of energy to rural areas' and focuses on the most disadvantaged sector of education in South Africa, that is, schools in rural areas. The analysis attempts to take account of the needs of these schools so that electrification supports their participation in key education programmes which require electricity (or another source of energy).<sup>1</sup> It recognises that energy needs of schools must be considered within the framework of emerging policies concerning the provision of energy to rural areas. The Rural Development Strategy of the Reconstruction and Development Programme (RDP) proposes that integrated energy planning will lead to synergy between development and fuel delivery that recognises the multi-faceted nature of rural energy needs (RDP, 1997). All energy sources are being considered and include, electrification, policies to secure fuel wood supplies, and options to improve access to petroleum fuels. The implications of these policies are likely to influence patterns of provision in various sectors, including education.

Even though there are a variety of types of education institutes in rural areas - providing educare, skill-training, technical and tertiary education - the focus of this paper is energy provision to schools offering education from Grade 1 to Grade 12 and to providers of adult basic education and training where schools are the sites of instruction.

The report begins with a discussion on whether the electrification of schools is indeed a fundamental requirement for meeting key development priorities enunciated by the national and provincial education departments, particularly in supporting principles of democratisation, access, equity and redress. The analysis is based on an examination of post-1994 education legislation and policies as well as programmes currently being planned and implemented and extended by a brief examination of the potential impact of electricity, which incorporates international and South African studies.

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Recommendations in the final part of the report address the lack of national and provincial education policy guidelines regarding a strategic plan for the provision of energy services that expedite the implementation of educational development initiatives. Further recommendations point to the need to establish a clear framework for financing electricity at schools and provide on-going support to schools and other educational institutions, which advance the sustainability of the service. In addition research is needed to examine changes in user practices arising from the provision of electricity, at school and households, that affect teaching and learning.

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<sup>1</sup> The analysis concentrates on Eskom as it is the major provider of electricity in rural areas.



## 2 Impact studies: Education and rural electricity

Impact assessments of the provision of electricity, nationally and internationally, rural and urban, were found to be extremely sketchy, especially regarding changes induced by the provision of electricity. In general we find that studies do not provide longitudinal or cross-sectional data on usage within rural communities and their institutions. No information was found which critically compared the opportunities and constraints provided by different forms of energy required for supporting teaching and learning endeavours. We conclude that installation should be coupled with in-depth impact studies which show the ways in which educators and learners make use of electricity, how this usage influences teaching and learning practices, and the support systems needed to ensure optimal usage.

### 2.1 Electricity - an essential service?

The view that electricity does promote development is highly contested. On the one hand it has been argued that:

A reliable supply of electricity is essential to the long-term economic development of rural society; without it, rural communities are condemned to existence on the margins of the modern world.... Rural electrification on its own, does not cause development. But where the necessary conditions are present, it has a major impact on the form that development takes. (Foley, 1990. p 1)

On the other hand it has been proposed that electricity is less important in school development programmes than the provision of other basic facilities and services. For example, Thom, in her analysis of the Eskom School Electrification Programme, questions 'the priority placed on school electrification in particular, as it is probably one of the least critical inputs to improve the quality of education in South Africa' (Thom et al, 1995, p 47). Such reservations arise from assessments of the current status of many schools in South Africa. As discussed below, there is a substantial shortage of classrooms in South Africa, many schools lack water, sanitation and essential teaching aids and teacher upgrading programmes are urgently needed. Faced by these daunting constraints, these researchers question the priority accorded to the provision of electricity to schools.

Clearly, aspects of both these arguments are valid. Where electricity provision is adequately supported, it has the potential to impact on education in diverse ways. Well-lit classrooms and outside lighting may under some circumstances encourage adults, especially women, to attend night classes. Similarly, electricity at home might ease the burden of household duties for children, allowing them to spend more time on school activities and could improve teachers' quality of life in their homes and enrich their teaching practices by enabling them to make use of a greater diversity of teaching aids and equipment.

However, many questions remain. For example, under what conditions are benefits manifested? What are they? Are they evenly distributed throughout the community? And could these same benefits accrue from other resources? Inequities inherited from the past critically shape learners' experiences. Children from wealthier (white) urban areas have access to technologies similar to those of learners in first world countries; sophisticated computer programmes are becoming commonplace in homes and classrooms and duly influence learning practices. International studies illustrate the varied uses of electronic technology and telecommunications in classrooms and the ways in which these provide a range of educational experiences for learners. In the Northern Territories of Australia, for example, local councils in Yirrkala run a core centre which has a number of satellite stations thereby improving the quality of education in remote rural areas (Purdon, 1997). Computer-based delivery of early education for children of itinerant families in Australia has improved the learning environment for children whose families frequently shift location (Lally, 1990). Section 4 illustrates some computer-based innovations in South Africa's more advantaged schools.

On the other hand, impact studies of electricity provision in schools managed by the former African departments of education yield results similar to those in the most deprived

classrooms in the world, where electricity is seen to be less important than other services. Here a different set of indicators prevail which focus on access and improving teaching and learning practices. Borchers et al (1994) illustrate how electricity enhanced access to education and helped to extend teaching time in a study of a community in Botswana. Without supportive facilities and appliances, few benefits arise from electricity provision in junior primary schools, as indicated by Davis and Nghikembua (1995) in their study of Namibian schools. In contrast to this, these authors found that secondary schools used a variety of electricity-linked appliances and equipment for teaching and administrative purposes, in the hostels and classrooms, which had been acquired when generators were used in the schools. Thus educational level and access to appliances influences usage patterns.

A growing number of South African studies flesh out experiences relating to electricity provision in South Africa, and particularly the use of solar photovoltaic panels (Cowan, 1990; Bedford, 1996; Geerdts, 1996). These reinforce Davis and Nghikembua's (1995) findings of limited impact in situations where other basic services are sorely needed. Responses consistently reveal that electricity is considered less important than other facilities such as water, more classrooms, teaching aids or improved transport. Even though the stakeholders in Bedford's study did not perceive electricity to be a key priority, as lack of classrooms and teachers were seen as more limiting, teachers said upgrading did depend on providing a range of appliances and equipment.

Geerdts (1996) interviewed teachers from four schools in the former Transkei where solar photovoltaic panels had been installed. Teachers stated that electricity was not a key priority in view of the critical shortage of resources and basic facilities and services at the school. Nevertheless schools made sporadic use of lighting to extend teaching time and to provide for activities at night.

Findings pointed to various out-of-school constraints on development activities such as low levels of infrastructural development, high levels of poverty and importantly, confusion over the status of various local level institutions. Bedford (1996), in her pre-electrification study of schools and clinics in the former Transkei, for example, maintained that there was no coordination between local level structures even though a range of institutions - political, development (including school committees) and social institutions - had participated in the electrification process. The reason appeared to be that the planning process did not inform, let alone generate, a dialogue with local structures: '...in fact, in most cases, the process has at best been one of *informing* villagers and local structures rather than *consulting* with them.' (Author's emphases, p 15). This lack of consultation extended to the tribal authorities. In fact Bedford (1996) concludes that: 'If effective consultation with local people is to succeed it will have to be undertaken by the key institutions or organisations at local level' (ibid, p 33).

Various reports provide valuable technical inputs on the technologies used and associated costs. Cowan (1990) evaluated the use of PV technology in an educational TV and video programme, Edutel, in schools in the former Bophuthatswana. He found that the technology was well-suited for use in remote rural areas, despite performance being less than expected in some contexts: 'The hardware ... represents an elegant and well engineered solution to a specific problem - how to provide TV and video facilities in non-electrified rural schools' (p xii).

In spite of the suitability of the technology, the programme was not well-received. Top-down planning, little consultation with teachers, poor quality software and informants' claims that political motivations and commercial interests played a dominant role in decisions to proceed, served to undermine the programme and implementation was marked by resistance and under-utilisation. Future programme developers would do well to take heed of Cowan's concluding cautionary remarks:

The main lesson is that new technology must mesh satisfactorily with local capabilities, structures and aspirations, otherwise it can reinforce rather than diminish the dependency of underdeveloped regions (p xvi).

Finally, the need for integrated planning across sectors was emphasised by the authors of the evaluation of the planned non-grid Independent Development Trust rural electrification

programme (Energy and Development Group, 1993). The IDT programme was to have supplied power for lights and a power point to run an overhead projector, a video machine, a television set or a computer at secondary schools<sup>2</sup>. In their analysis of the programme, the authors argue for an integrated energy programme that takes account of other needs, such as lighting at homes of educators and children and outdoor lighting for security purposes. They maintain that the provision of equipment and appliances should take account of the fact that energy needs at a school may change over time.

## 2.2 Conclusions

### The importance of supportive management systems

Electricity needs for education were shown to be potentially more diverse than those required for other sectors as they may: extend teaching time; facilitate the use of security systems; provide outdoor lights to allow safe access to school at night; and equip teachers and non-teaching staff to use various teaching aids, alternative media and office equipment.

But it is clear that where schools are inadequately resourced, the impact of electricity on teaching and learning tends to be minimal. A primary reason for this is that schools do not have the requisite skills and resources to manage the service.

Capacity building programmes are therefore an essential part of any project which deals with electrical installation. These must develop relevant skills and knowledge about: the use and maintenance of electrical appliances; safety features of the system; and associated costs. Security is also paramount and the department must ensure that all equipment is safely kept.

### Clear lines of communication and consultation

Confusion about roles and functions of various structures and organisations impeded delivery in villages, as did top-down delivery, indicating that schools must be fully aware of installation procedures and participate in all stages of the planning and installation process.

### Shortcomings in research studies

A major caveat in all impact studies reviewed, nationally or internationally, rural or urban, is that information tends to be extremely sketchy, especially regarding changes induced by the provision of electricity:

- No studies were found that detailed administrative and pedagogical practices in school subjects which may require energy before and after installation of electricity.
- None of the studies surveyed provide pre- and post-installation information on household activities as they relate to teaching and learning.<sup>3</sup>
- Where additional educational activities were implemented, such as night classes or reading laboratories, no evidence is given of the extent to which the facility was used and the performance outcomes for learners.

User patterns during or after school and changes in behaviour and performance levels at schools resulting from the provision of electricity (or other sources of energy) are not understood. Studies are needed which look closely at the nature of the changes in school performance arising from the provision of electricity if we are to justify the substantial costs involved in provision. Future studies might include in-depth interviews and

<sup>2</sup> The IDT programme was never implemented, as Eskom subsequently took over responsibility for all school electrification.

<sup>3</sup> For example, if electrifying houses and schools could be expected to free girls from collecting firewood to do their homework in afternoons and facilitate school attendance, we could expect to find improved retention rates amongst girls at school and decreased failure rates. This requires that researchers examine girls' daily activities at home and school and their changes in school performance over time.

observations of teaching practices, patterns of homework practices, the ways in which teachers cope with their marking loads, with and without lighting in their homes, and how different sectors of the community use electricity, with particular reference to gender and age. Longitudinal studies are needed to examine the long-term impact of electricity on various aspects of school development. Finally, it is critical that we understand the levels of support and training required to empower educators and learners to make optimal use of the equipment provided. The fact that this information is not available reinforces the need to carefully monitor and evaluate the Eskom programme.

### 3 Education in rural areas of South Africa

The context of rural education and policies regulating education in rural areas is covered in the following section of the report.

Education is in a parlous state in many communities in South Africa. But it is in the rural areas - both on commercial farms and in the former homelands - that learners are most disadvantaged. Many schools do not have basic facilities such as water, sanitation and electricity and teaching aids and equipment. Large classes of more than 50 learners per teacher are not uncommon. Teacher's living conditions are often inadequate, particularly on the farms, resulting in teachers commuting long distances to work each day. Schools vary enormously in size. Some schools on commercial farms may have less than 20 learners and multigrade classes. Others, on farms or in the former bantustans, are extremely overcrowded - classes of more than 50 learners not uncommon. Learners in farm schools are often far older than their urban counterparts because schools may be far from their homes, preventing young children from attending. In some cases education is disrupted because children have to work on farms.<sup>4</sup>

Prior to the passing of the South African Schools Act (see below), other than schools in small towns, rural areas were serviced by two categories of schools; on farms and in the former homelands. Although they have many features in common (such as isolation, infrastructural constraints, high levels of poverty) the politics framing the policies around these two types of school differs substantially from one another. Within the two categories, a variety of forms of provision can be found resulting in differences in the quality of teaching and the provision of resources.

#### 3.1 The political economy of rural education

Schooling for education of the children of farm workers was a direct expression of the labour dispensation for farm workers; it arose out of a situation where workers were explicitly excluded from basic conditions of employment, and the work was primarily of an unskilled nature. Skilled workers were seen as a threat to the establishment which was organised along feudal lines. Because a significant proportion of farm workers were women and children, farm schools were designed to ensure the stability of the labour force; schools were a 'carrot' to prevent children from seeking education elsewhere and hence leaving the farms. The farm school was therefore an integral part of the labour system.

Similarly, the education systems created in the former homeland education departments followed the dictates of the apartheid state's plans for these regions. Unlike the farms, however, education provision was provided at secondary school levels primarily to prevent migration to urban areas. Nevertheless economic and political structures established by the apartheid state constrained education delivery.

The rationale underpinning funding policies for education in rural areas was based on the political ideology of the times:

First, the homeland governments lacked any real power in the decision-making processes around budgeting. Second, decisions about spending

<sup>4</sup> By law, farmers are no longer allowed to remove children from school to work on the farm but figures indicate that child labour on farms is the highest category of child workers in South Africa. The shortage of classrooms means that children may not get to school, or may have to leave school before completing school, to make them available to work on the farm.

or addressing backlogs ... were made in isolation from the needs of communities. Third, there was little incentive for the homeland governments to be accountable for their spending decisions. Fourth, the financing requirements for the farm schools were dependent largely on motivation by the farmers themselves and neglected community needs and demography of the area.... The consequences of this policy for rural education have been a lower allocated proportion of the budget, substantially lower per capita expenditure, higher teacher-pupil ratios and school buildings which remained in an appalling states of neglect (Pillay, 1995, p 1).

## 3.2 Policies regulating education in rural areas

### Schools on commercial farms

The 1953 Bantu Education Act created the category state-aided schools to accommodate children of farm workers. In 1990 there were approximately 5 800 schools (27% of all Department of Education and Training schools) on farms providing primarily primary school education to 520 000 (7%) learners (DET, 1995). This figure has decreased significantly in the last five years as a result of the decrease in the number of farm workers in South Africa.

The establishment of a school depended on the willingness of the farmer or property owner to provide education for the children of their workers. Regulations entitled farmers to open and close schools on their properties and make decisions regarding which learners were to be allowed to enroll and the educational level of schools. The state provided furniture, textbooks and teachers' salaries and subsidised buildings. Until the latter half of the 1980s subsidies were minimal but by 1993 the subsidy covered 100% of building costs and 50% of maintenance costs. If farmers accepted a state subsidy they were required to keep schools open for 20 years, or else repay a proportional part of the building costs. However this was unlikely to occur in practice; if farms were sold, the agreement between the State and the former owner was not binding for the new owner and he could close the school, if he so wished. As owners of the property, farmers were able to control all aspects of school life. The Trespass Law allowed him to prevent pupils from attending the school and to dismiss teachers, even though they were department appointees. These regulations resulted in schools on farms being the poorest and worst resourced in the country.

Farmers were responsible for providing and paying for services; hence few schools on farms have running water or electricity. In the Free State, the extension of grid electricity to schools has been included in the subsidy arrangements for worker housing. Schools located close to the houses are included in the programme and treated as additional houses. If schools are too far away, funding for the electricity is requested from Eskom's Community Development Fund (Thom et al, 1995, p vii). Numbers of schools where electricity has been installed are low: for example in the Free State, 108 schools and clinics were electrified as part of this programme between 1989 to 1995.

### Community schools

Community schools were the dominant type in the former homelands and comprised 30% of the schools and 38% of learners (DET, 1995). Built and maintained by communities, often with no subsidy from the state<sup>5</sup>, most schools were in a wretched state, and had difficulty in attracting experienced teachers.

Traditional leaders had an important influence in the governance of many rural community schools although their real power varied from community to community and from area to

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<sup>5</sup> Prior to 1994, the official policy was to reimburse schools on a R for R basis for building costs but this did not happen in many cases. In any event schools were paid back only after they had built the classrooms, so the communities had to fund the entire building operation before being refunded.

area, depending on various historical, social, political and other factors. They were responsible for allocating the land on which a school was built and generally controlled the collection of community funds for classroom building. Their position of power within the community gave them power over key school decisions, despite the existence of a school committee with formal powers. This led to a system where education in the bantustans was not uniformly poor: if a chief or headman supported education, the schools in the district could be substantially better than others in the district.

Where services were provided, payment was generally the responsibility of the school with funds being generated by school fees.

### 3.3 Service delivery in rural areas

Statistics on the nature and extent of facilities and services are being collected for all schools in South Africa. The School Register of Needs is a survey project to establish a geo-referenced database of all primary and secondary schools in South Africa. The project has been undertaken by a consortium comprising the Education Foundation, the Human Sciences Research Council (HSRC) and the Research Institute for Educational Planning (RIEP) (University of the Free State). By the end of 1996 all schools in the country had been located and a database established covering over 300 fields of infrastructure and enrollment information. (EDN, 1996).

This process is accompanied by a development and implementation training programme for national and provincial officials to enable them to use information for planning purposes. National and provincial education management information system directorates have been established which will establish information systems.

At the time of writing, reports on the Free State and the Northern Province had not been released but the maps of services for these and the Eastern Cape were available. Table 1 summarises this information. Until all data are available, exact information on the numbers of schools without electricity, and the type of provision<sup>6</sup> at schools, cannot be established.

Province	Free	State	North	Prov	East	Cape	North	West	North	Cape
No. schools	2888		3479		5695		2593		525	
Facility	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)	Yes (%)	No (%)
Power	43	57	22	78	20	80	48	52	82	18
Phones	27	74	34	66	19	81	37	63	82	18
Water										
-indoor	17		8		9		17		54	
-outdoor	61		53		49		67		38	
-none	22		26		34		7		1	
-communal			14		6		8		4	

Table 1: School Register of Needs Survey: Information on basic service (Edusource, HSRC and RIEP).<sup>7</sup>

<sup>6</sup> Respondents indicated whether schools were:

- \* Wired and supplied with electricity
- \* Wired but not supplied with electricity
- \* Not wired and/or no electricity available
- \* [supplied with] generators
- \* [supplied with] other energy sources

The third response covers both schools which are connected but do not wish to pay electricity bills as well as those which are wired but there is no electricity available.

<sup>7</sup> Figures are unlikely to reflect the number of solar photovoltaic panels installed and schools connected to the grid during 1996 as data were collected in early in 1996.

### 3.4 Conclusions

The poor state of many of the schools in rural areas raises concerns that electricity is being installed in many schools which lack the infrastructure to operate the equipment effectively. The need to provide schools with support is therefore paramount. These issues will be explored in later sections of the paper.

Information from the Schools Register of Needs Index can be used to plan strategic interventions to provide facilities and services which ensure that all schools have access to electricity, if not at the school, then at the local district offices or at another educational institution within a reasonable radius of the school.

## 4 The policy framework for the education and training system and accompanying legislation

### 4.1 Goals and values

It is not only education in schools in rural areas and disadvantaged urban areas that require transformation. Even though sections of the education system are highly developed it was characterised by: a centralised finance system coupled with top-down governance; a curriculum that promoted rote learning, rather than promoting critical thinking and problem-solving skills, and academic education at the expense of vocational knowledge and skills; corruption and fraud in a number of departments. Furthermore it was extremely inefficient owing to the fragmentation of the education system into 19 racially and ethnically distinct departments.

The late 1980s witnessed the beginning of negotiations around a new framework for education and training by the mass democratic movement culminating in a various policy proposals (National Education Policy Investigation, 1995) and since 1994, a range of policy documents and legislation which aim at fundamental transformation of apartheid education.

Several policy documents have described the vision underpinning the new education and training system. Recognising the historical experiences of colonialism, racism and apartheid, these documents, and the legislation currently being enacted, aim to redress past inequities, provide an education of high quality for all learners, advance the democratic transformation of society, combat racism and sexism and all other forms of unfair discrimination, contribute to the eradication of poverty and the economic well-being of society (Government Gazette, 1996b). Redress programmes are attempting to overcome the backlog in classrooms and basic facilities

The goals, values and principles of the new education and training system are summed up in the Report of the Task Team for Technology-Enhanced Learning Investigations in South Africa (Department of Education, 1996a, p 11):

- a commitment to providing access to quality education, and a right to basic education as enshrined in the Bill of Rights;
- a commitment to developing the full potential of South Africa's people for their active participation in all processes of a democratic society and their contribution to the economic growth and development of the country;
- redressing imbalances of the past through the implementation of new teaching and learning strategies for the effective and flexible delivery of services within various learning contexts and through the equitable distribution of technological and other resources;
- implementing learner-centred and outcomes-based approaches to education and training in order to achieve quality learning based on recognised national standards;
- enabling all people to value, have access to and succeed in lifelong education and training;

- developing a problem-solving and creative environment in which new technologies are harnessed to produce knowledge, products, and services;
- integrating technology into the strategies intended to reach these goals so as to advance South Africa's ability to harness new technologies in its growth and development.

Restoring the culture of teaching and learning depends on ensuring accountability; this will be effected by devolving decision-making to parents, the principal and teachers.

The White Paper on Education (February 1995) advocates Open Learning as an approach to increase access to education and to improve the quality of education:

Open learning is an approach which combines the principles of learner-centredness, lifelong learning, flexibility of learning provision, the removal of barriers to access learning ... (Government Gazette, 1995b, p 28).

## 4.2 Decision-making structures

### Provincialisation

The Constitution spells out the education responsibilities of the national and provincial governments. The national government is responsible for University and Technician education as well as for the development of norms and standards and the conditions of employment and service of teachers in school and college education. The provinces have full responsibility for the administration of school education, teacher training, technical and other colleges.

Since the beginning of 1995 a task team to facilitate the provincialisation of education has been operating from the national Department of Education. The overall goal of the team is to allow the new provincial departments to assume functions that were previously held by a variety of authorities. A complicating factor is the uneven state of development, both of the various authorities within a province and between provinces, as well as racial disparities which impact on the process. For example, in the Free State the task was fairly simple as three key departmental structures (House of Assembly, Department of Education and Training, and QwaQwa) had to be amalgamated. In the Northern Province the process was particularly difficult as the overblown, inefficient departments of four of the former homelands had to be amalgamated with the House of Assembly, the Department of Education and Training, and the House of Delegates. The 1st April 1995 marked the legal end of the 19 racially based education departments and the establishment of a system of a single national department and nine provincial departments of education.

By the end of 1995 provinces had begun the process of putting into place proper administrative structures. For example, the Free State has been divided into 12 districts and the Northern Province and Eastern Cape into six regions. These districts are not only administrative offices as they were in the past, but in time will fully manage schools. Therefore this move is part of the process of change from centralised to decentralised control. A report in Edusource Data News (EDN, 1996) indicates that the provinces have taken over virtually all planning and administration relating to education. Nationally-planned and managed projects of the former RDP Culture of Learning National Education Office are being substantially devolved to the provinces.

### Devolving decision-making to enhance democratisation

After intensive negotiations and public debate, the South African Schools Act was passed in 1996 and is currently being enacted. It creates a framework for the establishment of a coherent and democratic system of schooling by determining how schools will be organised and governed and providing a framework for the funding of schools based on user fees. Its significance lies in the fact that it is the first attempt by the government to establish a system driven by principles of equity and redress.

In attempting to create coherence out of a public system which comprised a range of types of schools with different funding formulae and governance regulations, the Act defines two categories of schools: public schools and independent schools. At present 98% of schools



fall into the public sector. The schools referred to in this study are the public schools, and more specifically, the former state-aided community schools and farm schools. The process by which the state will obtain control over farm schools is discussed below, in so far as it relates to the provision of facilities and services to the school.

Each school will be governed by a governing body where parents form the majority. Other stakeholders are the educators, non-teaching staff and learners in secondary schools. Members of the community can be co-opted but will have no voting rights. In other words, farmers, who formerly controlled governance, should lose this control once the South African Schools Act is implemented. It is expected that all governing bodies will be elected during 1997.

The devolution of authority to institutional level will be accompanied by capacity building programmes directed to officials at all levels of governance as well as to the governing bodies. The mechanisms for achieving management capacity are being considered (Department of Education, 1996c). Delays in implementation are likely owing to the lack of capacity in provincial departments.

Previous policy proposals and reports and the South African Schools Act lay down procedures whereby schools on farms can function as other public schools (Gordon, 1996). The MEC<sup>8</sup> of the province will be obliged to sign an agreement with each property owner which gives the department usufructuary rights over the school. Farm schools will then be part of the public school sector, having the same governance and management systems, and funded in the same way, as other public schools.

### Functions of governing bodies

The South African Schools Act gives the school community substantial decision-making powers although their responsibilities could differ between schools. Each governing body will be responsible for a set of basic functions which include adopting a constitution, developing the mission statement of the school, adopting a code of conduct for learners at the school, determining school times, administering the property and buildings and recommending the appointment of educators and non-educator staff.

Governing bodies may apply to the Provincial Head of Department to be allocated additional functions which include improvements of the schools property, determining the extra-mural curriculum of the school, purchasing textbooks and equipment for the school, and paying for services at the school. Therefore provincial departments will be responsible for the payments of all services but governing bodies can take over this function if they show the capacity to do so. In other words, the department will provide funds for services which the school will manage.

The reason for dividing functions into basic and allocative powers was to build on the actual experiences of governing bodies/Parent Teacher Student Associations/school committees which has arisen out of the diversity of their management experiences under apartheid. For example, many schools in the former homelands had taken responsibility for funding and building classrooms. The governing bodies of the former Model C schools had managed the financial affairs of their schools as well as financing and appointing additional staff members.

The payment of services by governing bodies raises a number of critical issues. If school governing bodies can receive the funds from their department to pay for electricity services, it would be beneficial for them to understand various aspects of energy provision, including ways of saving on electricity, using alternative energy sources to save money, or learning how to maintain the system themselves and therefore saving on maintenance and repairs. Therefore capacity building, a directive given in the South African Schools Act, should include training in energy provision. (This presumes that support is readily available from the provincial departments and the providers of the service.) A further issue is that the act does not suggest if and how differences in usage between the advantaged schools,

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<sup>8</sup> Member of Executive Council (the head of provincial government)

which make extensive use of electricity and water (swimming pools, lights for sports fields etc) and poorly resourced schools, will be considered.

At present governing bodies and district officials are struggling to implement change in a range of areas including governance. The radical transformation from a top-down centralised system to a system where schools take responsibility for management and governance will require considerable support from departments for a number of years. A great deal of responsibility is now at district level and many of these offices do not yet have their full staff complement. Therefore it is probable that many of the governing bodies will struggle to fulfil their duties for some years.

### 4.3 Financing education

With respect to finance, the national Department of Education will be funded out of the national budget. The provincial ministries of education will receive their budgets from their provincial legislatures and will have to negotiate over the allocation they will receive with the other ministries. According to Pillay (1995) there is no mechanisms to ensure intra-provincial redistribution to the areas of greatest need. 'In other words, the high degree of fiscal centralisation is moved one step down from the national ministry to the provincial level but there is no effective mechanism in place to facilitate, for instance, the distribution of resources for the development of farm and other rural schools' (p 16). The weak and fragmented rural lobby exacerbates this difficulty, indicating that schools in rural areas could be further marginalised under the new structures, particularly because of the vociferous urban voice. Because rural communities are isolated from mainstream politics and their voice is seldom heard, the commitment to equity will be difficult to achieve as rural communities will depend on political will at the centre to stake their claim for an equitable share in the budget.

The Fiscal and Finance Commission recommendations regarding the allocation of the budget attempts to tackle redress by means of a basic grant which is determined by weighted population figures. Rural people are weighted as 1,25 persons.

Greenstein (1997), in analysing the recommendations re budgetary allocations, comments:

... historically under-funded provinces will get more money per capita and the historically over-funded less....this could mean a significant shift in the way social needs are funded across the country. .... We should keep in mind, however, that the Fiscal and Finance Commission has no power to determine the allocation of money within the provinces - between or within sectors. Although shifting resources in education is one of the most important foundations of the grant formula, this is not translated directly into shifting priorities in the education budget itself, whether nationally or in any of the provinces.

Government funding for education appears to have reached its limit. In 1995/6 education's share of the budget was 25.8%, the highest allocation on the state's consolidated national and provincial budget. Therefore increased funds will not be available to equalise provision by simply allocating additional finance to formerly disadvantaged schools. Instead the budget will have to be reorganised to take account of redress issues.

The South African Schools Act empowers schools to take responsibility for obtaining funds through the private sector, NGOs and other organisations. Schools will be constituted as legal entities to perform these functions. A system of user fees will be introduced but procedures and formulae are being worked out. The difficulties which schools in rural areas will face when attempting to raise finance are manifold and are likely to result in increasing inequities between schools in urban and rural areas.

### 4.4 Special programmes and initiatives

#### The Reconstruction and Development Programme

Since its inception, the RDP provided funds for feeding schemes, the Primary School Nutrition Programme, a School Building programme, the Culture of Learning programme

and the electrification of schools. The Primary School Nutrition Programme and the Culture of Learning programme are both Presidential Lead Projects. Just under R473m was allocated to the Primary School Nutrition Programme in 1995/6, R86 million was awarded for the electrification of schools and R100m and R200m for Culture of Learning programmes in 1995/6 and 1996/7 respectively (EDN, 1996); During its first two years in operation, the Culture of Learning programme catered for physical improvement of school building but this focus will change to capacity building for school governing bodies in 1997 (EDN, 1995).

Creating classroom space is seen as a priority by all departments. The province with the greatest backlog is the Northern Province; of the shortage of 60 000 classrooms in South Africa, 35 000 are in the Northern Province. To address this would require R1,79 billion in the Northern Province alone whereas funds allocated to the total School Building programme is R1,2 billion for the year.

Even though new schools built under the auspices of the School Building programme are wired, they will not be connected if the grid network does not extend to the town or village. There is no liaison with Eskom in the formulation of project plans.

### **Educational television and radio**

In May 1996 the National Department of Education announced it had provided R40 million from its development fund to finance phase one and two of SABC's<sup>9</sup> new Education Broadcasting Service (EDN, 1996). This includes both radio and TV services. Educational television will begin broadcasting in the first half of 1997.

Prior to this, the radio broadcasting of educational programmes has been limited. One exception is the Open Learning Systems Education Trust which offers a series of daily programmes. English in Action, designed for junior school pupils. Over 1 400 schools participate in the programme. Evaluations of the programme indicate that the cost of batteries is prohibitive for some schools which then listen to the programme a few days a month (Malumo, 1996).

The national consortium of distance education institutes has been established and will implement distance education programmes using the electronic media.

## **4.5 The restructuring of the curriculum**

### **Curriculum 2005**

Apartheid education was driven by the approach known as fundamental pedagogics in which the teacher, with the aid of a single textbook, was paramount as the source of knowledge. Schools attempted to fill learners with huge amounts of information which they were required to absorb through rote learning and pupils were discouraged from questioning or challenging the material and ideas they were being taught. In general, the classroom environment was strictly controlled in terms of the resources available to pupils and the emphasis was on teaching a narrow set of tasks and techniques. The approach being adopted by the new curriculum is known as outcomes-based education. It stresses the development of critical thinking and learning skills rather than the content or input received during the learning process, and is likely to generate a major shift to resource-based learning.

Outcomes-based education does not prioritize content as the major goal of learning, but rather stresses the need for learners to acquire the knowledge, understanding and skills necessary to interact with a fast-changing world. The ability to learn throughout life is seen as the key to developing new knowledge, insight and experience.

*Source:* Perold et al. 1997.

<sup>9</sup> South African Broadcasting Corporation

In 1995 the Department of Education established a Consultative Forum on Curriculum which managed the production of policy reports relating to the structures for the development of national policy regarding the curriculum, the curriculum frameworks for education from grade 0 to grade 12, and the National Qualification Framework. Implementation of the new curriculum begins in 1998 and will be complete in 2005.

### The National Qualifications Framework

The new national system of education and training will be organised according to the National Qualification Framework (NQF). By establishing an integrated national framework with common standards for learning achievements, the NQF, will make it possible for all learners - adults and children - to realise the goal of lifelong learning (Department of Education, 1996b).

The qualifications framework and the associated certification will be based on three bands:

- General Education and Training which incorporates the compulsory phase of schooling (grade 0 to present standard 7/Grade 9) and its equivalent in Adult Basic Education and Training (Level 1)
- Further Education and Training which incorporates the post-compulsory pre-higher education phase of schooling and its equivalent in college and industry-based training (present standard 10/grade 12) (Level 2)
- Higher Education and Training incorporating diploma and degree level programmes. (Levels 3 - 8).

The NQF aims to increase access for learners to recognised qualifications by:

- integrating vocational and academic training at the level of Further Education and Training
- allowing for portability of credits across institutions
- recognising prior learning within the framework

The South African Qualifications Authority Act of 1995 calls for the establishment a statutory organisation, the South African Qualifications Authority (SAQA), to oversee the development and implementation of the NQF.

The SAQA has recently created standard setting bodies which will define levels and standards across all learning areas. This will allow for programmes from a range of organisations and institutions to be recognised within the NQF.<sup>10</sup>

Eight Learning Areas and seven critical outcomes have been identified by the SAQA. The former are: communication; literacy and language; human and social sciences; technology, numeracy and mathematics; physical and natural sciences; arts and culture; economic and management sciences; and life orientation.

Critical outcomes for the education and training system include the ability to:

identify and solve problems, work effectively with others as a member of a team, organise and manage oneself, collect, analyse and critically evaluate information, communicate effectively, use science and technology, and demonstrate an understanding of the world as a set of related systems. These outcomes will not only underpin all qualifications, but are coupled with a set of values that are considered important for learners e.g. participating as responsible citizens in the life of local, national and global communities and developing entrepreneurial skills (Marock, 1997).

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<sup>10</sup> It is envisaged that this process will enable relevant material, for example, the materials on energy being developed by the HEAT programme, to be recognised by the relevant standard setting body for inclusion in the curriculum at the appropriate level.

Commenting on resources needed to successfully meet the objectives of the new curriculum, Perold et al (1997) state that:

While we must anticipate that outcomes-based education will require a wide range of resources including audio (audio tapes and compact disk recordings), visual (posters, exhibits, displays), audio-visual (videos, presentations) and information technology (computers, Internet), it is likely that print will continue play an indispensable role, especially through books. This is partly a function of the traditional value of print in educational process, but also a function of the limited resources at the disposal of schools in poor communities. Tight budgets mean that these schools are unlikely to have access to electronic and other resources in the short to medium term, and that they will continue to be dependent on print as one of the key supports for learning.

### *Adult basic education and training (ABET)*

Increasing access to basic education and skill training to youths and adults formerly denied education is seen as a priority for personal development, to facilitate entry into the job market and to enhance productivity at work. As a result the both the Ministries of Education and Labour aim to bring Adult Basic Education and Training into the mainstream.<sup>11</sup> An estimated 15 million South African adults are not literate, the majority being women living in rural areas. Farm workers are the most disadvantaged of all groups, with approximately 85% being illiterate. Skill-training and

#### **Skill training**

Skill training cannot take place in a vacuum. The assessment of a capacity building education management programme which operated in a rural area illustrated that projects implemented by groups of learners were constrained by various factors. Access to credit was one constraint. Another related to the lack of appropriate equipment, including electricity-driven appliances. For example, one woman started a sewing project but found that the time taken to sew clothes by hand meant that her profits were minimal and she abandoned the project. Therefore access to credit to purchase an electric machine to boost output might have resulted in a sustainable project.

basic education programmes will therefore have to concentrate in rural areas where constraints arising from the limited infrastructure, the shortage of trained adult educators and the necessary finance to secure teaching materials are already hampering the introduction of programmes. Nevertheless it can be anticipated that programmes for adults will increasingly be offered and this requires establishing learning sites. In rural areas schools are most likely to become adult centres offering classes at night, making classroom lighting and outside lights prerequisites for night classes.

Findings from the Schools Register of Needs Index indicate that at present few schools provide adult education classes. For example, in the Eastern Cape 5,8% and 6,8% of the schools are used for adult education and community centres respectively.

### **Technology-enhanced learning**

Until recently there has been scepticism on the part of many educators on the role that technology can play in teaching - can the 'good teacher' be replaced by technological aids? Such notions are rapidly changing across the world as learning technologies are now highly interactive and computers become increasingly available to learners. Training needs of a changing job market has led to educators considering the introduction of distance learning within the context of open learning systems.

<sup>11</sup> The Green Paper on Skills Training was released at the time this paper was being completed. It is clear that the Department of Labour is committed to securing substantial funding for skills training. It is likely that implementation in rural areas will be problematical, particularly in areas where public sector involvement is limited.

Findings from some international studies on the use of electronic media to support distance education are contrary to the widely held assumptions that these can only be used in advantaged communities; programmes have been developed to counter disadvantage and marginalisation (Lally, 1990). It is apparent that telematics is increasingly being used in first and third world contexts. A UNESCO<sup>12</sup> report for example, discusses the use of interactive radio, two-way radio and computer-aided instruction in multi-grade classes, a feature of schools in isolated rural areas (Birch, 1995).

The National Department of Education constituted a Task Team to investigate the possibility of utilising a range of technologies to increase access to education and to improve the quality of teaching and learning. One reason is that telecommunications and the electronic media are being successfully used in many countries as a means of increasing access to education; learners can access education programmes from their homes or from community centres even if they live in remote areas. Educators can similarly access programmes to enhance their teaching.

The task team's report on technology-enhanced learning was presented to the National Ministry in July 1996. Serving as the basis for the Department's approach to the role of technology in education and training, proposals aim to locate the investigation into technology-enhanced learning within the operational principles of current policies. Technology will be used as a means of enhancing communication between educators and learners using appropriate and varied media. A potential benefit could be to increase access to educators and learners in rural areas to distance education programmes as a means of reducing their isolation. But the content of the programme as well as the format in which it is offered must be appropriate to the 'culture and wisdom' of the community (Birch, 1995, p 88).

Recommendations made in the report are based on an understanding that technology is only one part of the complex system of processes and relationships that make up the education and training system. Referring to institutes in rural locations they stress that the learning experiences must be driven increasingly 'by *how useful it is, at that time, for the learners' particular needs.*' (p 53, Authors' emphasis)

Even though some schools and organisations have initiated interesting projects such as the satellite links used mainly for the Africa Growth Network's post-matriculation programme and the school websites, it is recognised that a major constraint will be the lack of sufficient resources to integrate technology fully into learning and teaching. At present, technologies are standard, used in traditional and limited ways, and there is no overall framework for upgrading.

Future developments require an infrastructural backbone comprising telephones and electricity making it essential that structured partnerships develop between the education department and suppliers of electricity and telecommunications. Telkom's Rurtel project uses solar power to set up small telephone networks for rural communities and indicates the potential for reaching those schools targeted by Eskom's solar electrification project.

#### WESTERN CAPE SCHOOLS NETWORK

(<http://www.wcape.school.za/>)

The Western Cape Schools Network (WCSN), founded in November 1993, is a non-profit body currently consisting of 130 schools in the Western Cape area. It installs the requisite software in schools and provides a measure of technical support and has developed a handbook to assist schools in setting up and administering their network. In addition it runs a variety of training courses for its members, ranging from introduction courses to advanced training.

A recent document based on the Technology-enhanced Learning Investigation Report (Department of Education, 1997) emphasizes the need for coordination between service providers and education departments:

<sup>12</sup> United Nations Education, Scientific and Cultural Organisation

infrastructure development meets the need of the education and training system ... There is a real danger that the significant infrastructural development currently taking place in South Africa might end up being of limited value to the education and training system, unless structured relationships are established between the Department of education and major physical infrastructure providers such as Telkom and Eskom (pp 13 - 15).

The report also recognises the need to create a body of "indigenous knowledge" about the integration of different technologies into South African education and training.

### **Multiple Resource Community Centres**

An outcome of the Technology-enhanced Learning Investigation is a focused study on multi-purpose resource centres and their potential role in educational support, both in offering or transmitting programmes, and providing a base for management information systems.

#### **Multiple resource community centres (MRCCs)**

MRCCs have been seen as multi-sectoral educational delivery centres providing various education and training programmes. They could be part of a flexible delivery system together with community colleges, teachers' resource centres or other training centres.

Their functions include:

1. An effective spread of in-service programmes aimed at improving the quality of teaching at school and classroom levels.
2. Centralising the provision of basic resources required for the effective management of schools such as office equipment, access to a telephone/fax, some secretarial services.
3. The effective and creative use of distance education to all learners providing access to education and training.

#### **Functions and partnerships with Localised Learning Centres (LLCS) in the Free State.**

**( Rumbell, 1996.)**

Localised Learning Centres have been on the planning agenda of the Free State since 1996. They will be developed to coordinate teaching and learning capacitation and facilitation at locations throughout the Free State, at all levels of learning, with NGO involvement from the outset. Rumbell (1996) has proposed that 60 Localised Learning Centres be identified throughout the Free State, covering both urban and rural locations. Specific centres will cater for technology and the sciences.

A range of partnerships are envisaged, both internationally, nationally and locally, including the private sector and community-based organisations and will interact with other government departments such as health, welfare, environment etc.

It is probable that activities in the next few years will involve building the capacity of teachers to cope with the new curriculum which is being phased in from 1998. One activity already on the agenda is the development of learning materials for delivery in January 1998.

The document by Rumbell points to the flexibility afforded by such a system, in terms of localised planning and the infusion of local knowledge in materials, choice of medium of instruction and trialing in the network of schools participating in the learning centre.

These centres should serve to reduce the isolation and marginalisation of teachers in rural areas, drawing them into the mainstream process of creating the new curriculum. Equipment to support these functions would vary according to the location. In other countries a large range of equipment is used that includes radio, two-way radio, computers, TV and video systems, interactive TV, fax, and satellites.

These centres which provide a range of educational services to various audiences, and cover a range of learning areas, have become popular in many countries.

In South Africa some provinces are establishing resource centres. The Free State, for example, has developed detailed plans on the range and functions of Localised Learning Centres ("Green Patches") and the Northern Province has established a centre at Seshego near Pietersburg.

#### **4.6 Equipment needed to support teaching and learning and the effective management of schools**

In this section of the report, consideration is given to equipment and aids that support good teaching and management practices at schools. This discussion must be regarded as tentative owing to the great diversity of schools in South Africa, the range of environmental and demographic, social, economic and geographical factors influencing schools as well as the resource needs of different disciplines and levels of education.

##### **Management and administration**

Devolving decision-making to district offices and schools is central to the process of democratising education, to ensure that local stakeholders play a decisive role in school management. Therefore district offices and schools are being, or will in future, be equipped to carry out management functions effectively. For example, if governing bodies are to raise funds and manage projects at their schools, they will require the necessary administrative back-up and support.

Schools will have to have access to basic office equipment - a computer, a printer, or alternatively a typewriter, a duplicator if no electricity is available, but preferably, a photocopier. (The present practice of writing tests or examinations on blackboards and hand-writing all school records can of course achieve the same outcomes as using modern equipment. The cost in time and effort to teachers and administrators, however, lowers motivation and deflects their efforts from more productive work to routine, tedious administration.)

It is anticipated that in the medium-term all schools will have a telephone (with the exception of those in extremely isolated regions of the country) and that in the medium-term all schools will have email. Ensuring that a member of the staff is computer literate will require the introduction of intensive training programmes.

##### **Security**

Outside lighting is a minimum requirement if classes are held at night. Some schools are installing burglar alarms because of high incidence of vandalism and theft.

##### **Recreation**

Night lighting for sports fields must be fairly low on any list of priorities as sporting events can take place during the day. It is unlikely that provincial departments will take on the responsibility for payment accruing from these activities. Nevertheless schools could hire out their facilities (sports grounds, school hall, classrooms) to the community, thereby raising funds to augment school fees.

##### **Curriculum**

Different learning areas have diverse needs regarding the provision of energy which may vary according to the level of education. Details are provided for senior science and Adult Basic Education and Training. Tentative suggestions are made for the Primary Schools Nutrition Programme as evaluations of this programme have suggested that the lack of fuel is hindering the effectiveness of the programme in rural areas.



<i>Sector</i>	<i>Learning area</i>	<i>Equipment</i>
<p><b>Adult Basic Education and Training</b></p> <p>Classes are likely to take place at the local school or community centre after school, at night, over weekends or during school holidays.</p> <p>If classrooms are shared with the local school, it is possible that the limit of three hours daily usage for solar photovoltaic panels would mean that Adult Basic Education and Training teachers might be limited in the use of equipment.</p>	Literacy and numeracy	<p><b>Administration:</b></p> <p>Photocopier</p> <p>Telephone</p> <p>Computer</p> <p><b>Facilities and services:</b></p> <p>Toilets and water</p> <p>Lights - classroom and outside</p> <p><b>Teaching equipment and aids:</b></p> <p>Printed materials</p> <p>Electronic aids such as TV, radio, computers to support distance education programmes.</p>
<b>Adult Basic Education and Training</b>	Skill training	<p><b>Administration:</b> as above</p> <p><b>Facilities and services:</b> as above</p> <p><b>Equipment:</b> Specific to training.</p> <p>Possibilities include: sewing machines, pumps for irrigation, equipment to support various trades.</p> <p><b>Energy source:</b></p> <p>Solar panel</p> <p>Diesel generator</p> <p>Other</p>
<b>Cooking facilities for the Primary School Nutrition Programme</b>		<p>Gas, wood, coal</p> <p>Other appropriate technology?</p>
<b>Secondary school science</b>		<p><b>Administration:</b> As for ABET</p> <p><b>Teaching Aids:</b></p> <p>Experiments: Gas for heating. Electricity for sections of the syllabus: (Solar photovoltaic panels may be limiting under some conditions).</p> <p><b>Safety features:</b> battery to be kept in a well-ventilated room.</p>

Table 2: Illustrative examples of appliances and equipment needed at schools for administrative and teaching purposes<sup>13</sup>

## 4.7 Conclusions

The South African education system is undergoing radical changes and new policies are addressing a range of issues including management and governance, access to all, curriculum transformation, and teacher upgrading. Electricity provision is one of the services needed to realise change. It is far from certain, however, that each schools must be

<sup>13</sup> It is important to note that the equipment cited in Table 2 is not definitive. At present learning area committees are drawing up the guidelines for the new curricula and these committees could provide valuable information on equipment and aids supporting the new curricula.

electrified in the short-term, bearing in mind the critical financial constraints facing the education sector and problems being experienced in meeting installation targets (see section 5).

Educationally-sound guidelines are needed on selecting schools to be electrified. One possibility is to electrify all secondary schools, and, within the primary sector, one primary school could be electrified within a cluster of schools and provided with essential equipment in the short-term. In time all schools within the cluster could receive electricity but until then, all schools could benefit from the equipment.

Equity considerations must take account of the school's (and learners') social and economic context and its location. It is well-documented that the main beneficiaries of electricity are the rich - those who can afford the bills and appliances (Foley, 1990). The same is true for schools and other educational institutions. Schools already in possession of equipment will be able to take advantage of the programmes and services currently being introduced that depend on electricity: such as television and radio broadcasting, the facilities on the internet and distance education materials. This differential between well- and poorly-resourced schools will increase unless these exigencies are acted on.

Finally, redress actions should take account of the fact that learners from rural areas are likely to experience greater difficulties in understanding subjects such as technology and science than their urban peers as they will not have had first-hand experience of many of the concepts taught. Therefore the department should ensure that schools in rural areas have relatively well-equipped laboratories to provide learners with such opportunities.

## 5 Eskom's School Electrification Programme

### 5.1 Introduction

Two aspects of the School Electrification Programme are considered. The first provides details of the programme covering funding, targets, time frames, installation procedures, equipment provided and maintenance. In the second, an attempt is made to capture stakeholders' understanding and perceptions of the process. To do this telephone interviews were held with Eskom officials at Eskom Head Office, Eskom provincial coordinators and education department officials in two provinces, the Free State and the Northern Province. (Those interviewed are listed in Appendix B.)

### 5.2 Background information

In 1994 Eskom implemented a highly ambitious programme to address the backlog in the supply of electricity to schools. The programme aims to provide schools with electrical service connections in areas located in electrified areas, or with solar photovoltaic panels in areas which are not part of the national grid. The original target was to connect 9 500 schools to the grid network and provide 16 400 schools with solar energy by the year 2 000. Presumably these figures were based on the (inaccurate) information available at that time. Current estimates indicate a large number of schools will not be electrified by the end of 1999.

The national Department of Education has not provided Eskom with guidelines for its electrification programme (DME, 1996; Hambly, 1996). Funding from the Department of Finance and State Expenditure is managed by the Department of Minerals and Energy for the off-grid programme, and control then passes from Eskom National to Eskom coordinators who work with provincial departments of education.

Recently Eskom implemented a number of pilot programmes involving Wind Turbines and hydro-power projects (Bezuidenhout, 1997).

### 5.3 Eskom's grid electrification programme

The grid electrification programme is funded by Eskom's Community Development fund (R15 million in 1995 and 1996 and R14 million in 1997), overseas donors and the RDP fund (R30 million in the 1995/6 year).

Grid connections are made to schools in areas which have already been electrified and to schools which are part of new electrification projects; in some cases the grid may be extended to schools where limited line extension is possible. The projected cost of electrifying 6 000 schools from 1997 - 2001 is R318 778 200 (Hambly, 1996).

The technical standards and specifications for the electrification of schools were compiled by Eskom, in conjunction with the Department of Minerals and Energy (DME) and the Department of Education. These include fluorescent lights for classrooms, principals' offices, staff rooms, halls and outside lights. Power points are fitted in the classrooms, headmaster's office, staff rooms and halls. Staff houses located on the school premises will also receive a point of supply and a prepayment meter.

From 1991 to 1996, 2 955 schools were connected to the grid network and plans for the years 1997 - 2001 are to electrify 1 500 schools per year, funded by Eskom's Community Development Fund (R15 million p.a.) and RDP funds. RDP funds have not been secured for the 1997-8 year and Eskom's contribution has decreased to R14 million (Seleka, 1997) which means that less than 500 schools will be electrified in place of the intended 1 500.

On completion of the project, the ongoing maintenance and operation of the relevant reticulation line and the point of supply is the responsibility of Eskom, and maintenance of the internal wiring that of the provincial department of education. In 1995 there was no single policy concerning tariffs and the metering of electricity consumption by schools.

The assistant coordinator of this programme (Seleka, 1997) claimed that regional Eskom coordinators were overworked as some had more than one job.

#### 5.4 Eskom's school off-grid electricity programme

The non-grid electrification group in Eskom's Technology Research and Investigations initiated the Remote Area Power Supply electrification programme. Launched in 1994 this programme aimed at electrifying 1 000 schools by March 1996 at a cost of R56 million obtained from RDP funds.

Eskom's schools off-grid electrification programme team includes a manager, a team of project managers and support personnel at head office and Regional Implementation Body managers who operate in the seven provinces in which the programme operates (Thom, 1996). The approach has varied over time and in the different provinces. Details of Eskom's approach to supplying schools with solar photovoltaic panels are given in various reports (Thom et al. 1995; Thom, 1996) and specific details are elaborated in the remainder of this section.

The photovoltaic system is designed to provide for classroom lights and power for certain appliances such as an overhead projector (OHP), a video machine (VCR) and television set (TV). It has been estimated that the system could provide sufficient energy for eight classroom lights, two office lights, an OHP or mono computer, a TV and VCR for approximately three to four hours per day. A notebook computer uses about one-eighth of the power of a mono computer and a computer with a colour screen about double the energy. The solar panel equipment can be expected to last between 10 and 20 years. Maintenance costs are approximately R3 000 per year. The system does not have the capacity for heating but could accommodate a photocopier.

In addition to free delivery, Eskom provides either the department or schools with an OHP, a TV set and a VCR (Bezuidenhout, 1997). In 1996 the cost per school was R56 000. Funds have been secured from the European Union to continue the programme. There are no guidelines covering maintenance costs.

Table three provides the schedules of schools that were to be provided with solar photovoltaic panels in 1996. Of the 1 654 planned, 987 schools were provided with solar photovoltaic panels.

Bearing in mind the financial constraints under which education departments are operating, and the difficulties arising regarding the future supply of electricity to all schools, the provision of equipment (approximately 10% of the budget) to schools as part of the solar system panel package, needs to be examined.

<i>Provinces</i>	<i>No. of schools</i>
1. Eastern Cape	1 211
2. Kwazulu Natal	70
3. Mpumalanga	201
4. Northern Province	35
5. Northern Cape	29
6. North West	108
<b>TOTAL</b>	<b>1 654</b>

**Table 3:** Scheduled installation of solar photovoltaic panels (1996) (Eskom, 1997)

### 5.5 The electrification of schools on farms

The nature of the subsidy system for farm schools has resulted in extremely limited services and facilities on farm schools, including the provision of electricity.

Eskom has been the major distribution agency electrifying households and schools on farms (Thom et al. 1995). In regions such as the Free State, where more extensive subsidy provisions have been made by district authorities, schools and teachers who live on the property have been able to avail themselves of electricity on the same basis as farmworker households. Even though 75% of commercial farms in South Africa are serviced by the grid, few worker households (22%) have access to electricity (Hofmeyr, 1994).

This situation should change with the promulgation of the South African Schools Act. Farm schools are now part of the public school sector so the department is now obliged to provide them with facilities and services on a par with all other public schools.

### 5.6 The participation of officials from national and provincial departments of education in the electrification programme

#### The national Department of Education

As outlined above, the national Department of Education develops policy guidelines and establishes the norms and standards for education. But at present there is no structure discussing norms and standards for the provision of facilities and services. Currently their involvement in the process of electrifying schools is through the Directorate of Project Management in the School Building project. The extent of their involvement is to supply new schools with wiring and tubing.

#### Procedures in the provinces

Thom et al (1995) provide a detailed outline of the communication process between Eskom and the provincial departments of education. This report extends this discussion using information gained during interviews with officials and one principal regarding the School Electrification Programme. Two provinces were canvassed, the Northern Province and the Free State.

Interviews focused on officials' understanding of the policy framework, the implementation procedures in which they participate, and the maintenance, training and security procedures engaged in by their department. In each section we analyse informants' responses, pointing out differences in opinion, procedures and possible contradictions.

#### *Institutional frameworks*

The Department of Works in both provinces, and directorates within the Departments of Education, Logistics, Security and Building (Northern Province) and Works and Physical Planning Services (Free State) are responsible for planning the installation of electricity.

Examining the organograms of the two departments, almost all of the directorates have some interest in the provision of electricity. Speculating on particular interests in the

Northern Province, for example, one could anticipate that "Curriculum and Education Technology" would wish to have a say in equipment provided to schools for the various learning areas. "Educational Structures and Statistics" will decide on the nature of equipment required to support the Education Management Information System; "RDP, Early Childhood Development and Adult Basic Education and Training" would have a range of concerns including the placement of centres to offer distance education, equipment needed for skill training and administration; "Arts, Culture and Language Services" would also be concerned about equipment and administrative support; "Library, Museum and Archival Services" might wish to access the internet; "Sport and Recreation" might wish to ensure that certain facilities can be lit at night; and "Human Resource Development" requires equipment for in-service teacher training programmes and an Education Management Information System.

The diversity of needs other than those related to delivery and maintenance indicates that provinces should consider coordinating the provision of electricity (and other facilities and services). Eskom could then plan its development strategies in conjunction with the needs of the education departments and users at school level.

### *Policy processes*

There was a degree of confusion over the details of the School Electrification Programme amongst all officials. This appeared to have arisen because policies developed by Eskom primarily deal with technical and financial considerations and are therefore dealt with by officials directly involved in the technical matters from the relevant directorates. Reports or policy statements do not appear to reach the desks of officials in other sections of the departments. In one case a senior official was not aware of the costs of electrification and had no knowledge of the equipment supplied to the Department or the schools. Officials at district and local levels directly involved in planning installation with school principals and the village development committees were unsure of the details of the policies. One official commented: 'If there is policy I am not aware of it'.

There is also a lack of congruence between key priorities defined by the department and the School Electrification Programme; in the Northern Province one official pointed out that electrification is of secondary importance as they are primarily concerned with addressing the backlog in school buildings and finding employment for the large number of unemployed teachers: 'Students attend in open areas and our full attention is on this' (Chauke, 1997).

Many of the officials interviewed were confused about the nature of the 'contract' with Eskom, and considered that Eskom was providing 'a helping hand' in electrifying schools and that they welcomed Eskom's generosity. Hence it is not surprising that they thought it correct for Eskom to control the decision-making process.

No rules guide us. If someone comes and says he wants to assist you wherein you do not pay any cent you should welcome that. (Chauke, 1997)

### **Implementation**

Eskom provincial coordinators and regional implementation body managers facilitate the grid and non-grid programme respectively, liaising with departmental officials. Responses illustrate that procedures differ between districts.

One Eskom coordinator interviewed sees himself as being on the 'technical side', and his role to facilitate liaison between Eskom and the Department of Works:

We contact the Department of Works to find out where schools are to electrify and negotiate with them to supply us with the names of these schools ... We are part of the forum which meets from time to time to find out what the need is from the Department. The forum consists of the people in the Department of Works, the Department of Education, one of the engineers and [an education official]... schools are chosen by the Department of Works ... the school is liable for a security system,

the fence must be in order and all the classrooms must have doors ... As far as I know, [the parents] don't play any role. The principal is the only one who reports to the district manager and he is the only one who reports to the Department of Works ... I don't know what communication they have [with the community]... (Wilkens, 1997).

Schools are selected on the basis of Eskom plans for the regions taking into consideration requests from regional offices who pass on requests by schools.

Look the process is two-fold. There are times when schools declare themselves to be in need of electricity and they channel their requests through our normal channels of circuits and those reach us here in the region and we coordinate. But there are times when Eskom identify certain schools or will electrify certain schools and they ask us if we can help them identify. We refer that to our circuits (Nkuna, 1997).

### Decision-making structures (local level)

Local structures (education officials, Transitional Local Councils and other community structures) in the Giyani district of the Northern Province appear to be coordinating their efforts to guide the extension of the grid system. For both grid and off-grid electrification, consultations take place at village level with the area manager representing the Department of Education in village committees together with SANCO<sup>14</sup>, councillors, teachers or the principal. A principal in the Northern Province said that in her village there is a committee elected by the community comprising community members and Eskom agents, unlike previously, when the principal, the chief, and councillors made decisions. Women are now part of these structures. Despite the fact that consultative structures have been established, the principal said the final say was with Eskom, who set conditions for connecting the village to the network (Golele, 1997). The limited say of this committee confirms Bedford's comments quoted above (Bedford, 1996, section 2) that consultations serve to inform communities, rather than generate dialogue, about different development options. Nevertheless district officials said they welcomed the decision to broaden the decision-making process by including school management.

### Inter-sectoral collaboration

Questions were directed to senior education management and Eskom coordinators on the extent of inter-sectoral consultation. Other than different organisations being represented at local council level, no meetings are held between the different sectors. It appears that the coordination of planning is seen to be an administrative and technical issue:

We have no committee. We have a unit of administrators. At community level fortunately we have Transitional Local Councils ... and our offices at district level, our circuit offices and area managers - we facilitate this involvement (Nkuna, 1997).

There are contacts with the Department of Education and Department of Works. We are in a forum that meets from time to time to find out what the need is from the Department of Education. The forum consist of people from Department of Works, Education, an engineer ... (Wilkens, 1997)

Nevertheless it was recognised that because of the diverse nature of projects being implemented, a more integrated approach to planning is becoming a necessity.

.... at our regional meetings I have been calling for interaction. ... RDP funds [are] not well coordinated. There are so many similar projects implemented in a distorted fashion. So I felt there was a need to coordinate all RDP projects. Electricity falls under RDP and it means

<sup>14</sup> South African National Civics Organisation

health needs, electrification, water, and agriculture [must work together]. (Nkuna, 1997)

### **Training/ Capacity building**

Informants revealed that training is confined to technical concerns such as demonstrating the equipment to school management on delivery. They pointed to the need for full-time maintenance staff and a functional management system (Mashile, 1997). It appears that other technical concerns such as the capacity of the system, safety features, and the equipment suited for a PV system, are hardly touched on, if at all.

### **Budget and funding details**

At present Eskom raises funds for the School Electrification Programme and it is apparent that few schools raise funds from other sources for the provision of electricity, despite the possibilities of private contractors installing solar photovoltaic panels.

Some funding for the electrification of villages is directed to the local council by the province but this does not finance school electrification in any way unless schools are in a village where the grid network is being extended.

### **Payment of school electricity bills**

In future it appears that provincial departments will be responsible for grid electricity and phone bills for all public schools. Nevertheless respondents were not clear who bore the responsibility for these services. In most cases Model C and farm schools were paying their bills but in the Northern Province the department was paying for electricity in the former community schools.

In the Free State, officials reported that they will not cover electricity bills for the former Model C schools:

The department pays the bills for all state schools, private and ex-model C excluded and the amount paid is determined by the number of units used by the school. This implies that payments is not the same... (Hayes, 1997).

In the Northern Province officials said that they would pay all the bills, However redress policies might be introduced:

It will depend on the nature of the circumstances. For example, if we compare two children, if one is sick, more attention is given to him or her. (Chauke, 1997).

Schools on farms remain a problem. Even though they are now part of the public school sector it is likely that, until the agreement discussed in section 3 is signed and the tenure of schools secured, electrifying schools will remain low on the list of departmental priorities. In the Free State which has the highest proportion of farm schools in South Africa, the intention is to electrify 286 of the 1 553 farm schools in 1997 and that a subsidy of R200 per school per month would be paid (Mopedi, 1997).

The Eskom coordinator (Free State) was less optimistic about the electrification of schools on farms.

The government says it is going to look after the farm schools, but what they are saying is not matched with what they are doing ... We are prepared to electrify the schools if the government pays the account (Wilkens, 1997).

If departments are to take over responsibility for all costs associated with facilities and services, some consideration will have to be given to equity issues particularly in view of the fact that the electricity bills of historically advantaged schools are likely to be extremely high compared to other schools and particularly those in rural areas.

## Maintenance

Maintenance costs for the solar photovoltaic panels are included in the budgets of the Directorate of Physical Planning and Works in the Free State and Northern Province respectively and that maintenance teams will be established by these directorates.

## Security

Eskom will only install solar photovoltaic panels at a school if the community ensures the safety of the equipment:

... the community will have to guarantee the security of the whole system, for instance in the meeting that we will be next week the communities will have to assure Eskom that their installations would be safe ... for instance promise that they will provide a security fence around the school and also provide security guards .. because if we do not have a security fence they won't touch the whole system.. The communities will also be encourage to provide security guards. (Mona, 1997)

Therefore the community is expected to bear the direct costs of security in terms of a fence and paying guards and some schools are in fact installing burglar alarms and outside lighting. This regulation might exclude the most disadvantaged schools from the electricity programme.

## Impact

Informants maintained that electrification has an impact on education stating that learners in electrified schools do better than others in non-electrified schools.

... since the teachers supplement their teachings by using electrical teaching aids, it is easier for the pupils to relate the information from the book with what is being displayed. They also gain more knowledge through participation during experiments. (Golele, 1997)

... [the impact] has not been quantified in concrete terms but logic can tell that there has been an impact.. There are already signs .. if you compare the output in terms of results say, Standard 10, if you look at our best schools they are schools that are situated in places that are electrified, students are able to study better, experiments are conducted better in electrified schools. That to me is the most important thing because we can measure the success. .... [but it is] not electricity alone, [it is] among others - the quality of teaching in that school and the climate in that school. (Nkuna, 1997)

One interviewee said that girls did not come to school to study at night because it was unsafe to do so. Nevertheless he felt classroom lighting was of benefit to the learners: 'As far as I am concerned, the pupils come after hours for reading. So that is an improvement'. (Mokoena, 1997).

### *The need for alternative energy sources for extra-mural programmes*

The lack of cooking facilities at schools directly affects the Primary School Nutrition Programme, having deleterious effects on learners who have to collect wood to cook food, as this evaluator of the Primary School Nutrition Programme notes:

The lack of fuel is another factor that limits the menu to a peanut butter sandwich. In some rural schools the community have taken the responsibility of supplying the school with wood. In other areas school children are expected to bring wood and this becomes a problem at times as it means children have to go to the bush to fetch wood. In one school teachers have reported that children no longer had enough time to do their homework. In the case of peri-urban and urban areas



schools complain of high electricity bills since the inception of the programme. (Saasa, 1996)

This problem could be resolved by developing various options of heating food which do not depend on electricity.

## 5.7 Critical analysis

### Vacuum in policy guidelines concerning facilities and services

Critiques of the School Electrification Programme maintain that the programme does not form part of a larger initiative to upgrade facilities and improve education and that: 'No clarity exists on the type of facilities requiring energy which are needed and will be provided at different schools' (Thom et al, 1995, p 41). Acquiring such information rests on a programme of action developed by the national and provincial departments of education, together with Eskom, which addresses education needs and priorities in a coordinated manner. Framework documents need to be accompanied by provincial implementation plans which realistically take account of regional needs.

### A flawed negotiation process

Even though electricity committees include education officials and/or school management, decisions are confined to whether schools will be connected to the grid or provided with solar photovoltaic panels. The specific details of the service provided - lights, power points, security lighting, equipment - are not seen as negotiable. This is particularly problematical for the off-grid programme as choices could be made regarding, for example, the equipment given as part of the installation 'package', or the costs of additional panels to increase the system.

One reason stems from the fact that officials view Eskom's actions as a 'a gift'. This process raises a number of concerns. Firstly, our interviews revealed that departmental officials had bought into this notion and therefore did not consider it appropriate for them to critique, or even suggest changes to, the programme. Obviously installation is not a gift; a great deal of the finance is from State expenditure or from donors for the specific purpose of providing schools with electricity, and suggestions from education officials at all tiers of management are essential to ensuring that the service suits the needs of the system.

A second concern stems from the consultation process. Its constrained nature is contrary to the principles underpinning the new policy processes. As outlined in section 4, the South African Schools Act allocates a great deal of authority and autonomy to governing bodies and this should be reflected in decisions about services, particularly as they will become responsible for them.

Thirdly, full participation in any negotiation depends on all sides having access to relevant information. This does not appear to be the case. During interviews, provincial and district officials revealed a lack of clarity on Eskom's planning framework. Indeed some did not know of one.

### Confusion over payment of bills

Despite current confusion over who is responsible for paying electricity bills, it appears that, in terms of the South African Schools Act, provincial departments will have to accept responsibility for these. Nevertheless the departments need to consider guidelines on their obligation to pay for electricity for 'luxury' items.

According to Lois Crouch, a consultant with the National Department of Education, guidelines are being drawn up by the Finance Subcommittee of Hedcom (heads of education departments) that will cover payment for services on a redress basis. These guidelines should include tariffs for the non-grid installations and maintenance, although it is unlikely that electricity costs will be specifically considered at present.

### **Inadequate security**

Both the grid and non-grid programmes have been plagued by vandalism and thefts (DME, 1996). Security problems relate to a bigger issue concerning whether one should provide a resource where there is no capacity to manage, protect and maintain the system.

### **Extending user training programmes**

Training programmes must cover technical aspects, safety and security, cost implications of the use of various appliances, and alternative sources of energy, particularly relating to heating. Training must be given to governing bodies as they will be responsible for paying for facilities and services.

### **Building in monitoring and evaluation procedures**

Impact studies illustrated the lack of information on a variety of issues underpinning policy planning. Performance indicators that measure technological aspects, usage and impact on teaching and learning, must be built into the programme (Energy and Development Group, 1993).

### **Integrating electricity provision with other energy and development initiatives**

There appears to be insufficient information available on the relative strengths and weaknesses of grid and non-grid provision, particularly as this pertains to issues of versatility, reliability, the future expansion of the system, operational costs, levels of support maintenance, and safety factors.

In analysing electricity usage in schools supplied with solar photovoltaic panels in the former Transkei, Bedford (1996) argues that the limited nature of the services supported by solar photovoltaic panels must be assessed more carefully to ascertain whether the actual usage justifies the costs. She argues further that unless energy is provided to a broader range of institutions and services, such as water systems, churches, pre-schools, crèches and teachers' houses, the current process might well result in a further marginalisation of remote areas.

A report by the Energy and Development Group (1993) comments specifically on issues arising with respect to the provision of solar photovoltaic panels:

- a variety of technical issues must be addressed; they affect the extent to which the systems meet user needs, reliability, maintenance requirements and so on.
- Financial costs need to take account of supply and installation as well as life-cycle costs which can be significantly more than initial costs.
- The high costs involved mean that managed partnerships are necessary to build the capacity of the solar PV industry to minimise the risks and maximise benefits.

### **Rethinking the equipment package**

For each solar panel installation, approximately R5 000 is spent on television sets, VCRs and overhead projectors, representing approximately 10% of installation costs. This should be reconsidered by provincial departments in consultation with teachers.

## **5.8 Conclusions**

It appears that both the grid and off-grid school electrification programme are not meeting the key objectives of the policies of the education departments. One reason is that implementation is narrowly conceived of in terms of installation; discussions with departmental officials are limited to directorates which plan and coordinate school building and maintenance, and directorates involved in curriculum planning and implementation, teacher upgrading and school management are not drawn into the planning process. To change this, national and provincial departments need to decide on the role of electricity in supporting the implementation of their policies.

A second set of concerns relate to management. Even though solar photovoltaic panels and other forms of remote area power supplies offer the possibility of bringing electricity supplies to communities which could not otherwise be reached, schools and districts offers must be provided with the resources to operate them. In a review of international experiences of remote area power systems, Foley's conclusion relating to generators is apposite to our situation:

[Such technologies]... soon fall into disuse unless they are accompanied by effective and permanent means of maintaining, repairing, and replacing the ... equipment (Foley, 1990, p 2.)

Planning is needed to address a constellation of management concerns, including training, security, safety, the payment of bills, and ensuring all appropriate departments have an effective information system, must be put into place about the grid and off-grid electrification programme.

Thirdly, it is likely that funds for equipment could be better spent. The equipment package for the off-grid programme should be re-thought and a range of options provided to allow schools to meet their particular needs. The advantages and disadvantages of using other energy options must be clearly spelled out.

## 6 Summary of main findings:

(These findings are based on a detailed examination of two provinces, the Free State and Northern Province. It is possible that other provinces have a different set of concerns arising from their particular relationship with Eskom.)

### 6.1 Financing school electrification

Eskom is responsible for obtaining funds for the school electrification programme which are then managed by the Department of Minerals and Energy. The national Department of Education plays no role in this process. As a result the planning process does not appear to take account of all key priorities of the national and provincial education departments, particularly if one considers the targeting of schools, the provision of equipment, and maintenance and operational costs.

#### Electricity bills

Provincial departments are or will soon be responsible for paying the electricity bills of all public schools connected to the electricity grid. Interviews with officials revealed that education departments have not developed guidelines on the payment of electricity bills, particularly where schools have a range of equipment and facilities which require electricity. Guidelines must include operating and maintenance costs of essential services and equipment.

### 6.2 Diversifying decision-making structures

The School Electrification Programme has been developed with little recognition of the diversity of activities at schools and the supportive facilities and services needed to ensure that they function effectively. In fact the decision-making process reflects pre-1994 channels of communication within the national and provincial departments when planning was coordinated by school building and maintenance directorates. Clearly input is needed from other directorates whose services may depend on the provision of electricity, such as ABET and curriculum affairs.

Recently however school and district personnel participate in decisions to connect the school/village to the grid or to install solar photovoltaic panels at the school.

### 6.3 Selected management concerns

It was found that training programmes for the off-grid programme deal with basic maintenance but do not provide information on the advantages of using electricity compared to other forms of energy, and the implication of using certain appliances. The

latter also applies where the school is connected to the grid network. This information is essential if schools are to take responsibility for facilities and services at schools.

Vandalism and theft of equipment are common. Eskom requires the school community to ensure the security of the solar photovoltaic panels and equipment by fencing the school and ensuring classrooms have doors with locks. These preconditions could lead to the exclusion of the most needy schools which therefore need support to manage the service.

#### **6.4 Meeting development needs**

In time it can be expected that electricity will be essential to ensure the effective delivery of current and future initiatives. Some of these are listed:

##### **Supporting an information system**

Office equipment, including computers, are essential for effective and efficient management. The likelihood of these becoming available to all schools in the short- and medium term is highly unlikely and therefore ways of ensuring that all schools have access to equipment must be found through strategies such as clustering schools or establishing core administrative centres.

##### **Curriculum reform**

Transforming the curriculum cannot take place without adequate teacher support and in-service programmes are increasingly being offered by tertiary institutes using distance education programmes. Although print will remain the dominant medium for many years, we can expect that many programmes will be conducted through the electronic media in the not-too-distant future.

Certain learning areas, particularly at the senior secondary level, and possibly during the last phase of general education, require equipment that must be supported by a stable energy source.

Appendix A provides details of the energy requirements for teaching senior secondary science. In this analysis, the author, Clerk, maintains that science cannot be taught at this level without some supply of electricity and it appears that solar photovoltaic panels, although not as convenient as a grid connection, will suffice. Similar analyses are needed to cover all learning areas at the different levels of education.

Public awareness programmes of new policies and instructional programmes are being relayed through national television. Means of making these available to rural communities is needed to prevent marginalising them.

##### **Open learning programmes, supported by various technologies**

The report by the task team on technology-enhanced learning points to the need to diversify modes of instruction to give more learners access to education and to provide a more flexible array of learning experience particularly to teachers, adults and youths living in remote areas of South Africa.

##### **Modes of provision**

Studies from a range of countries indicate the advantages of establishing learning centres/multiple purpose resource centres in rural areas. This is already being trialed in both the Northern Province and the Free State.

There is insufficient information on the capacity of off-grid systems currently being installed to determine whether they can be extended and upgraded to meet expanding needs, particularly if schools are to be used as multiple-resource centres, or to cater for the needs of different learners at different times of the day.

##### **Extra-mural and related programmes at schools**

The lack of any form of energy provision at some schools has a direct bearing on the Primary School Nutrition Programme. Where electricity is not available, learners may

miss school to collect wood. It appears that the lack of heating facilities serves to restrict the menu to sandwiches.

Findings suggest the possible expansion of night classes if schools are provided with lights and security.

### **6.5 Ensuring teachers' well-being**

Although few in number, studies in South Africa and Southern Africa found that some teachers claim that electricity is not a basic need in view of the poor condition of their schools. Even so they pointed out that educational aids can improve teaching practices and also encourage learners to use schools at night. As yet, there has been little consideration given to providing teachers' homes with electricity where solar photovoltaic panels are installed at schools, despite the benefits of extending teachers' preparation time.

### **6.6 Schools on farms**

The electrification of schools on farms remains problematical. At present property-owners and not the department of education decide whether or not to electrify the school and in most cases s/he is still responsible for all costs incurred.

## **7 Policy directives to facilitate the effective use of energy in rural schools**

### **7.1 Preventing the marginalisation of learners in rural areas**

It cannot be disputed that minimum requirements for all schools include secure and safe buildings, sufficient classroom space, water and sanitation, and safe access to schools. Provincial departments recognise these as fundamental elements of reform.

Nevertheless other reform measures prioritised in policy documents and legislation pertain to curriculum transformation, access to quality education and the implementation of an education information system. These require a diverse array of educational aids and office equipment, many of which are driven by electricity.

It is essential to ensure that schools in rural areas have the same potential to offer a quality education as schools in urban areas. This requires that arrangements must be made for them to obtain the necessary aids and equipment to do so.

### **7.2 Community ownership of energy programmes**

The driving principal behind the electrification programme should be that government and the public utility support community ownership of the programme and not vice versa. This can only be achieved if policies are based on community needs and practices.

### **7.3 Improving lines of communication**

At present it is apparent that many officials lack information on Eskom's School Electrification Programme. A reason is that the decision-making process is the same as those developed prior to 1994 as decisions are made by officials in directorates dealing with building services and the provincial department of Public Works. Other directorates, particularly those responsible for all curriculum-related activities, have a direct interest in electricity-supported technology, and should to be drawn into the process.

Eskom and the provincial departments need to reconsider line functions and communication between the various stakeholders, and develop new structures appropriate to the present policies.

### **7.4 National Department of Education**

The national and provincial departments of education should play a key role in formulating policy around facilities and services supporting transformation, including examining the cost implications of implementation, maintenance and support.

At national level, officials and Eskom agents will have to formulate guidelines on the suitability and sustainability of a range of energy sources, related implementation and maintenance costs, capacity development and integration with other sectors, such as water affairs. These must take account of Eskom's capacity to deliver and prevailing budgetary constraints as the electrification programme (grid and non-grid) is not likely to electrify all schools in the medium-term.

Consideration is needed on tariffs for the non-grid system (if these are to be introduced), maintenance costs, and the payment of bills for schools connected to the grid network so that provincial departments can prepare electricity budgets. Many 'historically advantaged' schools have in the past paid the bill for various 'luxury' items (such as swimming pools, floodlit sports fields and heaters) out of school funds and provincial departments will not be able to take over these payments. Therefore funding formulae must reflect the use of essential services required by all learners.

## 7.5 Provincial departments

Redistributing resources to ensure equality of provision is clearly not feasible in today's climate of severe budgetary constraints. Promoting equity demands that all learners must have the same potential to access basic education and training to which they are entitled, as enshrined in the Bill of Rights. This does not mean however that every school must be provided with a full range of equipment. Strategies are needed which enable educators and learners to access a wide variety of learning experiences, using various and suitable resources.

Provincial departments of education should provide district offices with various options designed to promote effective teaching and efficient management practices, allowing communities to decide on the facilities most suited to their particular needs.

Different options might delineate various modes of provision including: all schools having access to some form of electricity; secondary schools having suitable energy sources for various learning areas; all schools using office equipment and teaching aids at district offices or learning centres sited near schools; or a combination of these.

The specialised energy requirements of community learning centres must be determined. In time these centres could house equipment, provide support services to schools and offer the broader community access to telematics education and training programmes to suit their particular education and training needs. These initiatives would work in tandem with Telkom's Rurtel programme and other skill-training programmes.

Finances needed to cover installation, maintenance, security, management of the technology, insurance and technical support for hardware and software must be spelled out.

## 7.6 District offices

District offices must have the capacity to support schools and school clusters in managing the electricity service and equipment provided.

## 7.7 Governing bodies

In some provinces governing bodies and local education officials are already participating in consultative structures at village level. This process should be encouraged so that capacity building operates across the various sectors allowing planning at village level to be tackled in a holistic manner.

With specific reference to school management, governing bodies must participate in deciding on special features of the delivery package provided with the solar photovoltaic panel installation. Excluding governing bodies from decision-making is inimical to policies which devolve decision-making to school level, giving parents responsibility for school governance, including control over the management of facilities and services at the school.

## 7.8 Capacity building

Capacity building programmes relating to energy could be included in programmes on governance currently being planned for school governing bodies. It is essential that members of governing bodies are given training to ensure that their system is safe and effective, and that operational costs are kept to a minimum.

## 7.9 Teaching resources for Curriculum 2005

National and provincial learning area committees have been constituted. These could be requested to identify technologies and teaching aids for their particular learning area and the educational levels at which these are needed. Where appropriate, energy specialists could work with these committees to generate different energy options.

The package presented to schools receiving solar photovoltaic panels includes a television set, a video machine and an overhead projector. An alternative 'package' is recommended which offers schools, or school clusters, a flexible range of options. This requires an analysis of the resources required at various teaching sites, including primary and secondary schools, community learning centres, teacher resource centres, and youth and Adult Basic Education and Training centres.

## 7.10 Research, monitoring and evaluation studies

A programme of research is needed to develop a thorough understanding of user patterns relating to electricity and their effects on teaching and learning in households and at schools. Monitoring and evaluation is essential. Actual usage, technical faults and other problem areas could be monitored by the school. Other information pertinent to the impact of the various energy sources needs to be collected to ascertain whether the programme is meeting its goals.

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## APPENDIX A:

# Energy Requirements to Teach Secondary School Science

D Clerk, University of the Witwatersrand

### Rationale

Upgrading science teaching and increasing enrolment of African students in science are priorities recognised by the department of education. At a national level, SYSTEM (Students and Youth into Science, Technology, Engineering and Mathematics) aims at giving matriculants who failed mathematics a second chance to pass. At a provincial level departments are planning to retrain teachers to teach science, technology and mathematics as a means of ensuring that more learners enrol for these subjects and that the quality of teaching improves. For example, in the Northern Province one of the teacher training colleges now only offers dedicated in service training in these subjects. An obvious outcome of this is that schools will have to have the facilities to teach these subjects and the services to ensure that teaching can take place effectively. Therefore it is necessary to examine whether electricity is essential to the teaching of science. For the purposes of this document we will only examine the facilities required to teach senior secondary school science.

Science can be seen as an activity in which the scientist constructs explanatory conceptual models of given phenomena. Teaching of science aims to facilitate the construction of copies of such models in the mind of the learner. Learning is optimised if the learner actually witnesses the phenomena being modelled at first hand. In the urban environment many of the phenomena are familiar to the learner and thus the teaching of science 'on paper' is a feasible, if non-ideal undertaking. The situation is different in the rural environment where to many learners topics such as electricity are things they have only vaguely heard of. In cases like this, attempting to teach electricity in the complete absence of electricity would be about as successful as trying to teach cookery without food. Unless electricity is to be excluded in its entirety from the new curriculum, an electrical supply of some sort is a *sine qua non* for a properly equipped laboratory.

Science teaching must include three basic types of activities: teacher demonstrations, students' own practical work, and ordinary didactic teaching and learning. It would be most economical for these all to take place within the same room and my design attempts to allow this with a minimum of inconvenience.

What will electricity be used for?

- a) For the teaching of the topic 'electricity' in the physics syllabus.
- b) For running a variety of electrically operated apparatus for other topics.
- c) For running various teaching aids that are not science specific, see below.

Teaching aids:

- a) Nice-to-have: OHP, VCR and TV
- b) Essential aids for experiments:
  - Electricity
  - Heating facilities
  - Water supply

### Workstations:

Approximate dimensions: 1.5 m of perimeter bench per workstation.

Features: each station to have 1 gas outlet and 1 low voltage, DC and/or 1 mains AC electrical outlets (see comments later in document about energy requirements and electrical supply systems).

It would be possible to perform most of the available hands-on practical work required by the present curriculum including use of the RADMASTE 'micro' kits, microscope work, running electrical apparatus etc. at such a workstation.

## Sources of Energy.

An AC 'mains' supply would be adequate for all conceivable purposes and also provide maximum possible convenience for the teacher and the school administrator. Where possible it should be provided.

A low voltage DC system (supplied by a storage battery, recharged by solar photovoltaic panels) would serve most needs but at considerably less convenience and possibly greater cost in the long run. Such a system is often installed in first world laboratories as an additional luxury alongside a standard AC mains system.

## Energy supply:

### *Gas:*

Some means of heating reaction vessels is necessary and the versatility and effectiveness of the traditional, gas-burning bunsen makes it almost obligatory. Junior classes can perhaps make do with spirit burners but senior classes will need gas. Although 'stand-alone' portable burners are available, from the same company that makes the 'Bluet' camping stove (Camping Gaz), these would be expensive to buy, expensive to run and would also be eminently 'stealable'. My recommendation is that a system of gas pipes be properly installed to supply standard bunsens, fed from a large external cylinder which will have to be refilled periodically.

### Electricity

Apart from being needed to run certain equipment such as overhead projectors, computers etc. electricity is one of the major topics in the current science curriculum and there is no reason to suppose that it will be omitted from the new curriculum. As it is impossible to teach electricity in its absence, some form of electrical supply will thus be essential, an endless supply of dry cells being far too limited and prohibitively expensive.

It is not absolutely essential to have a mains AC supply at 220 V as some if not all devices can be run using low voltage DC. There are, however, certain considerations that must be mentioned:

Firstly most of the items commonly used in the laboratory, such as overhead projectors, are manufactured to use mains AC and will need to be modified to work with a low voltage DC supply. If it is not possible to buy such equipment suitably fitted for the purpose at the factory, retrofitting would be necessary which could prove prohibitively expensive.

Secondly, some items may function sub-optimally on low voltage, even if correctly retrofitted, for example: an overhead projector needs an exceptionally bright bulb in order to function adequately. The brightness of the bulb depends less on the voltage than on the current. If the low voltage system is not capable of delivering the necessary current, the overhead projector may well be unusable.

Thirdly; a suitable low voltage DC system could be supplied by a large storage battery, recharged by solar cells or a wind driven generator. Such a storage battery would be expensive to install, would need special care and maintenance and would need to deliver (at least sometimes) a large current for sustained periods. Each workstation would need a minimum of three amperes.

Fifteen such workstations operating simultaneously would thus draw 45 amperes. Add an overhead projector drawing say, 50 amperes and the total current becomes 95 amperes. If such a current were sustained for the duration of a 35 minute lesson, it would take several hours to return the storage battery to full capacity by 'trickle charging', which might mean that no other lessons of a similar nature could be taught until the next day. This delay would be even longer in rainy weather, if recharging were to be achieved by solar cells.

The currents likely to be running in such a system would necessitate not only a large (and therefore expensive) storage battery, but also wiring of a sufficient gauge to handle the current without undue heating, which would be another source of extra expense.

There would be no necessity, even at 'luxury' levels to install both mains AC and a low voltage DC system as a mains outlet at each workstation would allow the use of all possible devices, even those operating at low voltages and on DC, as transformers for the necessary conversion are standard school science stock.

In view of the comments above, the better option might be to install mains AC as it would be more convenient and perhaps even more economical than a self contained DC system, although the extreme remoteness of some locations may well preclude this.

#### Constraints:

**Size of storage battery:** The storage battery will need to be of such a size that will cope with running at average load for approximately 6 hours a day and that the PV system will be able to recharge the battery that same day.

50 A usage at any one time per science lesson, if the lesson requires electricity is not an excessive expectation: 15 workstations, each drawing 3 amperes will account for a total of 45 amperes. 15 workstations will accommodate 30 pupils (@ 2 per workstation).

Considering all the uses to which electricity can be used in any one day for teaching and administrative purposes it is likely that the total current drawn would be on average, somewhere between 30 - 50 amperes, assuming a 24 volt system (higher currents would be needed if the system were to run at 12 volts). Running for six hours at an average load of 40 amperes, the storage battery would need to have a capacity of about 240 ampere-hours and the PV system would need a corresponding capacity to recharge it within a reasonable time, assuming that the battery were to be completely drained before recharging commenced. In reality recharging and draining would occur simultaneously and thus the capacity of the battery could perhaps be less than suggested, but not by much as at times the current would be higher than average, and at times inclement weather could retard the charging process. A good storage capacity would also be essential if the school were to be used at night, as the possibility of recharging before school next day would be precluded.

It should be noted that the average current figure of 40 amperes is actually quite a modest estimate, based on the notion of simultaneously running an unrealistically low number of electrical devices: at 24 volts, ten 60 watt light bulbs, together draw 25 amperes; a 150 watt VCR and monitor combination draws 6.25 amperes and 15 workstations in the science lab at 3 amperes each, together draw 45 amperes. Running these together will result in a current drain of 76.25 amperes. A 2000 watt electric kettle will draw just over 83 amperes; new total: 159.25 amperes! This begs the question: will the storage battery and the wiring be able to cope with currents of this size or will the secretary have to find another way to make tea for the principal? Using mains AC is far less problematic, as with higher voltages, lower currents are required to run electrical devices of equivalent power and there is also less energy wasted as heat. Another problem hitherto unmentioned is that of safety. Although a low voltage system is no more dangerous than a high voltage one, there is a tendency for users to regard low voltage systems as less dangerous and this is a dangerous misconception. To operate at equivalent power, at low voltage any device must draw a higher current. The system is thus designed to deliver high currents and in case of mishap, high currents can be lethal. If, as is often the case, the user is unaware of this, the likelihood of mishap is increased through carelessness.

An option to consider during the planning stages: The school could be wired for both the low voltage system and as for mains AC. The AC system could either lie dormant until a mains supply is provided at a later date while the school functions on the low voltage system in the interim. Alternatively the AC system could at any stage be supplied by a diesel driven generator. This would allow for the eventual (or even immediate) conversion from the low voltage supply to mains without the added expense of retrofitting.

The heating of reaction vessels can best be achieved using standard Bunsen (butane) burners, these are actually better for the purpose than any possible electric heaters. A system would best be plumbed in permanently and supplied by an outside cylinder as stand-alone (gas) burners are far more expensive, both to purchase and to maintain.

## APPENDIX B: Interviewees

### National Department of Education

Mr D Chetty, Deputy director, Project planning  
 Dr T Coombe, Deputy-Director General  
 Dr L Crouch, Consultant  
 Mr V Naidoo, Director.

### Northern Province, Department of Education.

Mr H S Chauke, Deputy director: Building Services  
 Dr Z M Chuenyani, Superintendent General  
 Mrs N D Golele, Principal: Gija-Ngove High School  
 Mr S S Mashilo, Deputy director: Energy management (Department of Public Works)  
 Mr D Maselesele, Personnel  
 Mrs T Mona, Area manager  
 Mr W W X Nkuna, Regional director

### Free State, Department of Education

Mr T Hayes, Deputy Director: Department Works and Physical Planning Directorate  
 Dr B Khoali, Deputy Director General  
 Mr D Moloabi, Director  
 Mr T M Mopedi, Director Farm School Division  
 Mr T M Mokoena, Deputy principal: Libertas Combined School  
 Professor F Rumboll, Director, Free State Education Institute  
 Mr F R Sello, District official

### ESKOM

Ms S Bezuidenhout, Programme manager, Non-grid electrification  
 Ms A Hambly, Programme manager, Grid electrification  
 Ms P Seleka, Assistant manager, Grid electrification  
 Mr H Wilkens, Regional coordinator, Free State  
 Mr F van Staden, Regional coordinator, Northern Province.

### Other:

Ms J Glennie, Director, South African Institute for Distance Education.  
 Ms H Perold, Consultant.  
 Ms A Purdon, tutor, University of the Witwatersrand.



# **Facilitating education in rural areas of South Africa: The role of electricity and other sources of energy**

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**ADELE GORDON**

